2021

BENGALI

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

(উত্তর সাধু বা চলিত যেকোনো একটি ভাষারীতিতে হওয়া বাঞ্ছনীয়।)

'ক' বিভাগ

(*যেকোনো একটি* প্রশ্নের উত্তর লিখুন।) ৫০×১=৫০

১। (ক) ইন্দো-ইউরোপীয় আর্যভাষা থেকে বাংলা ভাষা কীভাবে সৃষ্টি হয়েছে রেখাচিত্রসহ বিশ্লেষণ করুন। প্রসঙ্গত প্রতিটি স্তরের কালসীমা ও সাহিত্যিক নিদর্শন উল্লেখ করুন। ৪০+৫+৫=৫০

(খ) নব্যভারতীয় আর্যভাষার বিভিন্ন স্তরগুলির নাম লিখুন। প্রতিটি স্তরের কালসীমা উল্লেখ করে উপভাষাগুলির উল্লেখ করুন। নব্যভারতীয় আর্যভাষার ধ্বনিতাত্ত্বিক ও রূপতাত্ত্বিক বৈশিষ্ট্যগুলি উদাহরণসহযোগে আলোচনা করুন। ১০+১০+১৫+১৫=৫০

'খ' বিভাগ

(*যেকোনো দুটি* প্রশ্নের উত্তর লিখুন।) ৫০×২=১০০

২। 'শ্রীকৃষ্ণকীর্তন' থেকে 'অন্নদামঙ্গল' মধ্যযুগের বাংলাসাহিত্যের সর্বত্রই আমরা দেখতে পাই এক ধরনের দেববাদ নির্ভরতা। দেবতা বা দেবী বিষয়ক মঙ্গলকাব্য বা পালাগান রচনার প্রেক্ষাপটে কোনো আর্থ-সামাজিক কারণ কী নিহিত আছে?— যুক্তিসহ আলোচনা করুন।

৩। মধ্যযুগের বাংলা সাহিত্যে চৈতন্যজীবনী সাহিত্যের উদ্ভবের কারণগুলি বিশ্লেষণ করুন। আপনার মতে কোন চৈতন্যজীবনীটি সর্বাপেক্ষা গুরুত্বপূর্ণ—যুক্তিসহ আলোচনা করুন।

৪। ঊনবিংশ শতাব্দীতে বাংলা গীতিকবিতা উদ্ভবের কারণগুলি ব্যাখ্যা করে, এই পর্বের গুরুত্বপূর্ণ পাঁচজন গীতিকবির কবি-কৃতিত্বের পরিচয় দিন।

৫। রবীন্দ্রনাথ বাংলা ছোটোগল্পের প্রথম সার্থক স্রষ্টা এবং অন্যতম শ্রেষ্ঠ স্রষ্টা। রবীন্দ্রনাথের বিভিন্ন পর্বের ছোটোগল্পের বৈশিষ্ট্য উল্লেখ করে মন্তব্যটি বিশ্লেষণ করুন।

'গ' বিভাগ

(*যেকোনো একটি* প্রশ্নের উত্তর লিখুন।) ৫০×১=৫০

৬। বাংলা উপন্যাসের ধারায় ঔপন্যাসিক বঙ্কিমচন্দ্রের কৃতিত্ব আলোচনা করুন।

৭। 'বন্দ্যোপাধ্যায় ত্রয়ী' হিসেবে চিহ্নিত হলেও তারাশঙ্কর, বিভূতিভূষণ ও মানিক বন্দ্যোপাধ্যায়ের লিখনশৈলীর মধ্যে আপাত কোনো মিল নেই। প্রত্যেকেই প্রত্যেকের থেকে স্বতন্ত্র। তারাশঙ্কর, বিভূতিভূষণ ও মানিক বন্দ্যোপাধ্যায়ের রচনার সাপেক্ষে মন্তব্যটি বিশ্লেষণ করুন।

৮। আধুনিক বাংলা কথাসাহিত্যের ধারায় সমাজসচেতন লেখক হিসেবে আশাপূর্ণা দেবীর কৃতিত্বের মূল্যায়ন করুন।

2021

HINDI

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored. The figures in the margin indicate marks for each question.

Group-A

1. हिंदी भाषा की सामान्य विशेषताओं पर रोशनी डालते हुए यह प्रमाणित करें कि विश्व मंच पर हिंदी भाषा की महत्ता स्थापित होगी। 30

अथवा,

भाषा के विभिन्न अवयवों की चर्चा करते हुए भाषा की परिवर्तनशीलता के लक्षणों का निरूपण करें।

2. स्वतंत्र भारत में खड़ी बोली की रचनाधर्मिता का विवेचन कीजिए। 20

अथवा,

हिंदी भाषा की विभिन्न बोलियों के अंत: सम्बन्धों का विवेचन करें।

Group-B

3. हिंदी साहित्य के आधुनिक काल की सामान्य प्रवृत्तियों पर प्रकाश डालिए। 30

अथवा,

हिंदी भाषा और साहित्य की प्रगति में आचार्य महावीर प्रसाद द्विवेदी की भूमिका का मूल्यांकन करें।

4. प्रगतिशील काव्य-धारा का विवेचन कीजिए। 30

अथवा,

हिंदी उपन्यास के उद्‌भव और विकास पर अपना विचार व्यक्त करें।

5. हिंदी रंगमंच की उपयोगिता पर संक्षेप में विमर्श प्रस्तुत कीजिए। 40

अथवा,

हिंदी आलोचना की प्रगति में आचार्य हजारी प्रसाद द्विवेदी के योगदान की समीक्षा अपने शब्दों में करें।

6. निम्नलिखित में से किन्हीं *दो* प्रश्नों के उत्तर संक्षेप में लिखिए: 25×2=50

(क) आधुनिक हिंदी कविता में दिनकर का स्थान निरूपित कीजिए।

(ख) नई कविता की महत्ता पर प्रकाश डालिए।

(ग) नागार्जुन की कविताओं में प्रकृति-प्रेम का विवेचन करें।

(घ) हिंदी कथा साहित्य में भीष्म साहनी का क्या अवदान है, तर्कपूर्ण उत्तर प्रस्तुत कीजिए।

(ङ) हिंदी आलोचना में राम विलास शर्मा के योगदान पर टिप्पणी करें।

2021

ENGLISH

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Section-A

1. Write an essay on *any one* of the following topics: 40×1=40

   (a) Literature can give us access to a more holistic understanding of our past than the official texts of history

   (b) Social media can be more damaging than beneficial to a society

   (c) Literature can play a role in changing societies

Section-B

2. Answer *any two* of the following questions: 40×2=80

   (a) Give two ways in which a tragedy is different from that of a comedy. Discuss with reference to Shakespeare's plays *Macbeth* and *As You Like It*.

   (b) What is 'Metaphysical' about John Donne's poetry? Explain with reference to the poems you have read.

   (c) Give one feature of Wordsworth's poetry that may be said to be an influence of the French Revolution. Illustrate with reference to the poems you have read.

   (d) What qualities of the West Wind does Shelley want to make his own? How do the images of nature indicate Shelley's political views?

   (e) What are the differences between Ulysses and Telemachus? Would you agree with the argument that both of them have the qualities of a hero? Give a reasoned answer.

   (f) 'So, one day more am I deified./ Who knows but the world may end tonight?'
   Explain the lines. How do these lines reflect the spirit of the Victorian Age?

Section-C

3. Answer *any two* of the following questions: 40×2=80

(a) Discuss briefly the economic condition of any *four* characters as portrayed in Austen's *Pride and Prejudice*.

(b) How does Thomas Hardy portray the conflict of the old and the new in *The Mayor of Casterbridge*? Write a brief note relating the novel to the social context of the age.

(c) Discuss the portrayal of Orlick, the labourer who works at Joe's forge with Pip, as Pip's dark shadow.

(d) Why have several critics accused Mark Twain of confirming rather than challenging the racial stereotypes in his portrayal of Jim in *The Adventures of Huckleberry Finn*?

(e) Would you agree with the view that in her novel *Frankenstein* Mary Shelley questions the pursuit of knowledge within the context of the industrial age? Give reasons for your answer.

2021
URDU
PAPER-I

Time Allowed : 3 Hours *Full Marks: 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to prescribed number shall be valued and the remaining ones ignored.
Answer should be written in ***Urdu.***

Group: A

1. جدید ہند آریائی زبانوں سے متعلق اپنی واقفیت کا اظہار کیجئے۔ 30

یا

''اتنی بات تو ہر شخص جانتا ہے کہ اردو زبان برج بھاشا سے نکلی ہے''
اس قول کی وضاحت مع دلائل کیجئے۔

2. قطب شاہی دور میں اردو زبان وادب کے سمت ورفتار کا جائزہ لیجئے۔ 30

یا

فورٹ ولیم کالج کی ادبی خدمات کا جائزہ لیجئے۔

Group: B

3. ولی دکنی کو بحیثیت غزل گو پیش کیجئے۔ 30

یا

مسجد قرطبہ کا تنقیدی جائزہ لیجئے۔

4. فیض کی نظم ''تنہائی'' کا تنقیدی جائزہ لیجئے۔ 30

یا

تثلیث حیات کی روشنی میں پرویز شاہدی کی شاعری کا جائزہ لیجئے۔

5. کسی دو پر نوٹ لکھئے: 10×2=20

(الف) بنجارہ نامہ

(ب) جوش ملیح آبادی

(ج) دلی اسکول

6. میر انیس کو بحیثیت مرثیہ نگار پیش کیجئے۔ 30

یا

ترقی پسند تحریک اور اردو غزل پر مفصل گفتگو کیجئے۔

7. درج ذیل اشعار میں سے کسی تین کی ناقدانہ تشریح کیجئے۔ 5×3=15

(الف) نقش فریادی ہے کس کی شوخیٔ تحریر کا
کاغذی ہے پیرہن ہر پیکرِ تصویر کا

(ب) منعم کے پاس قاقم و سنجاب تھا تو کیا
اس رند کی بھی رات کٹی جو کہ عور تھا

(ج) آیا تو سہی وہ کوئی دم کے لیے لیکن
ہونٹوں پہ مرے جب نفس باز پسیں تھا

(د) جذبۂ بے اختیار شوق دیکھا چاہئے
سینۂ شمشیر سے باہر ہے دم شمشیر کا

8. درج ذیل رباعی کا مرکزی خیال واضح کیجئے . 15

کھینچے ہوئے سر کو تو کہاں پھرتا ہے؟
پیری میں بہ شکل نوجواں پھرتا ہے
عرصہ ہے جہاں کا اس قدر تنگ و حقیر
خم ہو کے زمیں پہ آسماں پھرتا ہے

2021

SANSKRIT

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answer may be written either in **English** or in **Bengali** or in **Sanskrit**, but all answers must be in one and the same language, unless otherwise specified.*

Group-A

1. What do you understand by Indo-European family of languages? Answer in detail. 30

Or,

What is a Phonetic Law? Explain and illustrate Verner's Law and Collitz's Law. 30

2. Define and illustrate *any two* of the following: 10×2=20
   (a) Optative
   (b) Assimilation
   (c) Ablaut
   (d) Diphthong

Group-B

3. Explain *any two* of the following rules in Sanskrit: 10×2=20
   (a) साधकतमं करणम्।
   (b) भीत्रार्थानां भयहेतुः।
   (c) तत्र तेनेदमिति सरूपे।
4. Account for the case-endings in *any five* of the underlined words by citing the relevant rule of Pāṇini in each case: 4×5=20
   (a) *विषं* भक्षयति।
   (b) *जपमनु* प्रावर्षत्।
   (c) *पुष्पेभ्यः* स्पृहयति।
   (d) नमस्कुर्मो *नृसिंहाय*।
   (e) नाहं त्वां *शुने* मन्ये।
   (f) *शतस्य* दीव्यति।
5. Name and expound the Samāsa or compound in *any five* of the following: 4×5=20
   (a) *सतृणमत्ति।*
   (b) *उन्मत्तगङ्गम्।*
   (c) *धान्यार्थः।*
   (d) *काकपेया* नदी।

(e) *यूपदारू।*

(f) *घनश्यामः।*

(g) *त्रिभुवनम्।*

6. Justify *any two* of the following in Sanskrit: 10×2=20

(a) उपर्युपरि वुद्धीनां चरन्तीश्वरवुद्धयः।

(b) प्रणम्य शितिकण्ठाय।

(c) दृढभक्तिरसौ ज्येष्ठे।

(d) समानयंस्तुल्यगुणं वधूवरम्।

Group-C

7. Translate into English or Vernacular *any two* of the following: 10×2=20

(a) अग्निना रयिमश्नवत्
पोषमेव दिवेदिवे।
यशसं वीरवत्तमम्।।

(b) येनेमा विश्वा च्यवना कृतानि
यो दासं वर्णमधरं गुहाकः।
श्वघ्नीव यो जिगीवाल्लक्षादं
दर्यः पुष्टानि स जनास इन्द्रः।

(c) द्वेष्टि श्वश्रूरप जाया रुणद्धि
न नाथितो विन्दते मर्डितारम्।
अश्वस्येव जरतो वस्न्यस्य
नाहं विन्दामि कितवस्य भोगम्।।

Group-D

8. Translate from English into Sanskrit: 10×3=30

(a) If we have no respect of our teachers, then education is of no use.

(b) Now it is summer. The days are long and the nights are very pleasant.

(c) During the Puja holidays we went to the sea-side. The vast ocean with its huge waves charmed us all.

Or,

Translate into English from Sanskrit: 15×2=30

(a) स्वदेशवासिनां हृतशक्तेः लुप्तगौरवस्य चार्जनाय प्रतापः महतीं प्रचेष्टां कृतवान् परन्तु न हि सफलतामुपगतः।

(b) असौ जनः स्वगृहं प्रत्यावृत्य यत्र खलु एकदा तस्य निवासः आसीत् तत्र गृहद्वारे दण्डायमानां तस्य पत्नीमपश्यत्।

Group-E

9. Write a paragraph on *any one* of the following topic in Sanskrit: 20×1=20

(a) देशभ्रमणस्योपयोगिता।

(b) संस्कृतभाषायां तव प्रियः कविः।

(c) परिवेशरक्षणस्य महत्त्वम्।

2021

PALI

PAPER–I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Candidates may use ***Devnagari*** *or* ***Roman*** or ***Bengali*** Script in their answers. Quotations or expressions in Pali.

Group-A

1. Write a note on the origin and Homeland of Pali. 12
2. Write a note on the chief characteristic features of Pali. 20
3. Explain *any three* of the following phonetic tendencies in Pali, with suitable examples: 6×3=18
   (a) Assimilation
   (b) Metathesis
   (c) Loss of Dual number in Pali
   (d) Haplology
   (e) Epenthesis

Group-B

4. Write a note on the Sandhis in Pali. 18
5. Explain the formation of Desideratives *or* infinitives in Pali. 12
6. (a) Decline fully *either* Latā *or* Amha. 5
   (b) Conjugate *either* $\sqrt{\text{kar}}$ *or* ṭhā in the Aorist. 5
   (c) Give the Pali equivalents of the following Sanskrit words (*any five*): 2×5=10

   Sanskṛta, Saṁkleśa, Aṣṭāṅgika, Śrāvastī, Kusīnagara, Vaiśālī, Gautamī, Yaśodharā, Nairañjanā, Rājagṛha.

Group-C

7. Translate into English *either* of the following verses adding grammatical notes on the underlined words: 10+4=14
   (a) Manopubbaṅgamā dhammā manoseṭṭhā manomayā
   manasā ce paduṭṭhena bhāsati vā karoti vā
   tato naṁ dukkhamanveti cakkaṁ va vahato padaṁ.

(b) Na paresaṁ vilomāni na paresaṁ Katākataṁ,

attano va avekkheya katāni akatāni ca.

8. Translate into English *either* of the following prose extracts adding grammatical notes on the words underlined: 10+4=14

(a) Atha kho āyasmā Aṅgulimālo pubhanhasamayaṁ nivāsetvā pattacīvaraṁ ādāya Sāvatthiṁ piṇḍāya pāvisi. Iena kho pana samayena aññena pi leḍḍu khitto āyasmato Aṅgulimālassa kāye nipatati, aññena pi daṇḍo khitto āyasmato Aṅgulimālassa kāye nipatati, aññena pi sakkharā khittā āyasmato Aṅgulimālassa kāye nipatati.

(b) Yato kho, brāhmaṇa, bhikkhu indriyesu guttadvāro hoti, tamenaṁ Tathāgato uttariṁ vineti. Ehi tvaṁ, bhikkhu, bhojane mattaññu hohi, paṭisaṅkhā yoniso āhāraṁ āhareyyāsi n'e va davāya na madāya na maṇḍanāya na vibhūsanāya yāva-d-eva imassa kāyassa ṭhitiyā yāpanāya vihiṁsūparatāya brahmacariyānuggahāya iti.

9. Translate into Pali *either* of the following passages: 22

(a) Savatthi was the capital of Kosala and one of the great cities in India during Buddha's life-time. It lay on the banks of Aciravati. It was 45 leagues north of Rajagaha and 6 leagues from Saketa.

(b) Abhaya was the son of King Bimbisara. His mother was Padumāvatī, a courtesan of Ujjenī. At the age of seven, he was sent by his mother to the king's palace where he grew up with other princes.

Group-D

10. Write an essay in Pali on *any one* of the following topics: 50

(a) Majjhimā paṭipadā

(b) Asoka Dharmarājā

(c) Dutiya-Dhammasaṅgīti

2021

SANTALI

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given in Santali language and 'olchiki' Script.

SECTION-A

1. ᱡᱚᱛᱚ ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱚᱞ ᱢᱮ (Answer all the questions): 10×5=50

   (ᱚ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱮᱭᱟᱜ ᱵᱮᱱᱮᱜᱟᱨ ᱠᱚ ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱛ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱮᱭᱟᱜ ᱟᱲᱟᱝ ᱠᱚ ᱯᱩᱥᱴᱟᱹᱣ ᱛᱮ ᱩᱯᱥᱟᱹᱣ ᱨᱮ 'ᱚᱞᱪᱤᱠᱤ' ᱨᱮᱭᱟᱜ ᱫᱟᱲᱮ ᱛᱤᱱᱟᱹᱜ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫᱟ ? ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱜ) ᱥᱟᱱᱛᱟᱲᱤ ᱥᱚᱱᱚᱫ ᱞᱮᱠᱟᱛᱮ ᱜᱚᱴᱟᱝ ᱨᱮᱭᱟᱜ ᱦᱟᱹᱴᱤᱧ ᱠᱚ ᱫᱟᱹᱨᱠᱟᱹ. ᱥᱟᱞᱟᱜ ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱝ) ᱨᱩᱯ ᱥᱟᱶᱮᱥ ᱫᱚ ᱚᱠᱟᱠᱚ ᱢᱮᱛᱟᱜ-ᱟ ? ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱞ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱮᱭᱟᱜ ᱠᱤᱥᱟᱹᱲ ᱠᱤᱥᱟᱹᱲ ᱛᱮᱫ ᱫᱚ ᱦᱚᱲ ᱥᱟᱶᱦᱮᱫ ᱨᱮ ᱨᱤᱦᱤᱴ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫᱟ— ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

2. ᱡᱟᱦᱟᱸ ᱜᱮ ᱵᱟᱨᱭᱟ ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱚᱞ ᱢᱮ (Answer any two questions) : 25×2=50

   (ᱚ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱚᱱᱚᱲᱟᱱ ᱦᱚᱲ ᱫᱚ ᱚᱠᱟ ᱴᱷᱟᱶ ᱠᱚᱨᱮ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫ ᱠᱚᱭᱟ ? ᱢᱟᱱᱚᱛ ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ (Standard Santali Language) ᱛᱮᱭᱟᱨ ᱨᱟᱠᱟᱵ ᱨᱮᱭᱟᱜ ᱯᱟᱱᱛᱷᱟ ᱠᱚ ᱚᱞ ᱢᱮ ।

   (ᱛ) ᱚᱡᱟ ᱫᱚ ᱚᱠᱟ ᱠᱚ ᱢᱮᱛᱟᱜ-ᱟ ? ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱮ ᱚᱡᱟ ᱨᱮᱭᱟᱜ ᱦᱟᱹᱴᱤᱧ ᱟᱨ ᱞᱟᱜᱟᱛ ᱠᱚ ᱫᱟᱹᱨᱠᱟᱹ. ᱥᱟᱞᱟᱜ ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱜ) ᱯᱟᱹᱨᱥᱤ ᱥᱤᱨᱡᱚᱱ ᱨᱮᱭᱟᱜ ᱪᱮᱫ ᱪᱮᱫ ᱠᱟᱨᱮᱱ ᱠᱚ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫᱟ ? ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ।

   (ᱝ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱨᱮᱭᱟᱜ ᱩᱛᱱᱟᱹᱣ ᱞᱟᱹᱜᱤᱫ ᱱᱤᱛᱚᱜ ᱟᱜ ᱚᱠᱛᱚ ᱨᱮ ᱪᱮᱫ ᱪᱮᱫ ᱯᱟᱱᱛᱷᱟ ᱠᱚ ᱦᱟᱛᱟᱣ ᱨᱮᱭᱟᱜ ᱞᱟᱹᱠᱛᱤ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫᱟ ?

SECTION-B

3. ᱡᱚᱛᱚ ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱚᱞ ᱢᱮ (Answer all the questions): 10×5=50

   (ᱚ) ᱥᱟᱱᱛᱟᱲᱤ ᱥᱟᱶᱦᱮᱫ ᱩᱛᱱᱟᱹᱣ ᱨᱮ ᱠᱚᱲᱤᱜᱩᱥᱩ ᱥᱟᱹᱫᱷᱩ ᱨᱟᱢᱪᱟᱸᱫ ᱢᱩᱨᱢᱩ ᱟᱜ ᱮᱱᱮᱢ ᱚᱞ ᱢᱮ ।

(ᱛ) ᱥᱟᱹᱨᱤᱫᱷᱚᱨᱚᱢ ᱨᱮᱭᱟᱜ ᱢᱟᱡᱣ ᱠᱟᱛᱷᱟ ᱠᱚ ᱡᱚᱢᱥᱤᱢ ᱫᱤᱲᱛᱤ ᱞᱮᱠᱟᱛᱮ ᱥᱚᱜ ᱥᱮᱱᱮᱡᱣ ᱢᱮ ।

(ᱜ) ᱦᱟᱞᱮ ᱜᱮ ᱦᱚᱵᱲ ᱜᱟᱨᱟᱲ ᱨᱮᱭᱟᱜ ᱥᱟᱛᱟᱢ ᱟᱨ ᱡᱚᱥ ᱫᱟᱫᱚᱛ ᱚᱞ ᱵᱩᱡᱷᱟᱹᱣ ᱢᱮ ।

(ᱝ) ᱥᱟᱨᱚᱦᱟ ᱵᱨᱚᱥᱟᱦᱣ ᱠᱤᱥᱠᱩᱣᱟᱜ ᱚᱲᱚᱞᱦᱮ˙ ᱨᱮ ᱦᱩᱞᱥᱟ.ᱨ ᱟᱞᱟᱝ ᱚᱠᱟ ᱞᱮᱠᱟᱨ ᱥᱟᱫ ᱨᱟᱠᱟᱫ ᱟᱠᱟᱦᱟ ? ᱚᱞ ᱵᱩᱡᱷᱟᱹᱣ ᱢᱮ ।

(ᱞ) ᱥᱟᱱᱛᱟᱲᱤ ᱠᱟ.ᱦᱲᱤ ᱥᱟᱦᱤᱛᱮᱦ ᱨᱮ ᱨᱩᱵᱟᱹᱦᱣ ᱦᱮᱢᱫᱨᱚᱢ ᱟᱜ ᱮᱲᱮᱢ ᱚᱞᱢᱮ ।

4. ᱡᱟᱦᱟᱸ ᱜᱮ ᱫᱟᱨᱭᱟ ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱚᱞᱢᱮ (Answer any two questions) : 25×2=50

(ᱚ) ᱥᱟᱱᱛᱟᱲᱤ ᱦᱚᱲ ᱥᱟᱦᱤᱛᱮᱦ ᱦᱟᱨᱟ ᱫᱩᱨᱩᱵ ᱨᱮ 'ᱥᱤ˙ᱜᱟ.ᱲ ᱟᱠᱷᱲᱟ' ᱨᱮᱭᱟᱜ ᱢᱚᱦᱚᱛ ᱚᱞᱢᱮ ।

(ᱛ) ᱥᱟᱱᱛᱟᱲᱤ ᱥᱟᱦᱤᱛᱮᱦ ᱨᱮ ᱵᱟᱠᱩᱞ ᱡᱩᱡᱷᱟ.ᱨ ᱥᱚᱨᱮᱥᱟᱜ ᱮᱲᱮᱢ ᱚᱞ ᱵᱩᱡᱷᱟᱹᱣ ᱢᱮ ।

(ᱜ) ᱢᱤᱦ ᱠᱤᱛᱟ. ᱜᱟᱨᱟᱲ ᱯᱟᱨᱯᱟᱣ ᱨᱮ ᱫᱟᱦᱚᱞ ᱦᱮᱢᱫᱨᱚᱢ ᱟᱜ ᱮᱲᱮᱢ ᱚᱞᱢᱮ ।

(ᱝ) ᱫᱟᱵᱞᱟ ᱫᱤᱲᱛᱤ (ᱢᱟᱛᱠᱚᱢ ᱫᱩᱱᱟ. ᱜᱟᱞᱢᱟᱨᱟᱣ) ᱨᱮᱭᱟᱜ ᱛᱮᱛᱮᱦ ᱟᱨ ᱢᱚᱦᱚᱛ ᱚᱞᱢᱮ ।

2021

AGRICULTURE

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions. 40×3=120

1. (a) What is agro ecology and what are the agro-ecological factors? 10

   (b) Describe the role of climate and weather on crop production. 20

   (c) Write in brief precision farming. 10

2. (a) What do you mean by the greenhouse effect? 10

   (b) What are global warming and its impact on agriculture? 20

   (c) Write in brief the application of remote sensing in agriculture. 10

3. (a) Define cropping pattern and cropping sequence. 10

   (b) Describe the objectives, types and impacts of cropping patterns on High Yielding Varieties. 10

   (c) Write in brief recent changes of cropping patterns in the light of global warming and climate change. 20

4. (a) What do you mean by agricultural extension? 5

   (b) Write down the importance and role of agricultural extension in promoting and sustaining rural development. 15

   (c) Describe the principles and methods of agricultural extension. 20

5. (a) What do you mean by market-led extension? 5

   (b) Describe agricultural marketing with an emphasis on supply chain, pricing and market intelligence. 15

   (c) Write in brief the role of cold storage in the economy of agriculture. 20

Group-B

Answer *any two* questions. 40×2=80

6. (a) Critically discuss the role and function of Krishi Vigyan Kendra in the Indian context. 20

   (b) Describe the role of Self Help Group in agriculture with special reference to Womens' Empowerment. 20

7. (a) What is dryland farming and what is the different limiting factor in dryland farming? 20

   (b) What do you mean by water use efficiency in relation to crop production? Write in brief scheduling irrigation. 20

8. (a) Define soil and explain the factors of soil formation. Write in brief different problems of soil and their reclamations. 20

   (b) What do you mean by plant nutrition? Describe the role of essential elements in plant nutrition. 20

2021

ANIMAL HUSBANDRY AND VETERINARY SCIENCE

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be given either in ***English*** *or in* ***Bengali*** but all answers must be in one and same language.

Group-A

Answer *any three* questions.

1. (a) Give the importance of total mixed ration (TMR) in feeding dairy cow.

   (b) Mention the benefits and risk associated with the use of antibiotics as feed additives. What are the alternatives to antibiotics as growth promoters in poultry?

   (c) How dietary protein is digested by ruminants? 10+15+15=40

2. (a) Briefly narrate the development of poultry industry in India after independence.

   (b) Narrate the brooding management practices in India in different rearing system.

   (c) Mention the different managemental aspects of commercial lays farming. 10+15+15=40

3. (a) What is epistasis? How they modify classical Mendelian ratio 9 : 3 : 3 : 1 — discuss with example.

   (b) Gene and Genotype frequency of a population remains constant generation after generation — prove it.

   (c) Classify different types of outbreeding and their implication. 15+15+10=40

4. (a) Oestrus detection is a key factor for economy farming. Give various methods of oestrus detection in farm animals.

   (b) Define libido. Describe the various factors that influence the sex drive in bulls.

   (c) Discuss the clinical use of hormones in female reproduction with their side effects. 15+10+15=40

5. (a) Describe in detail about organic dairy products and its importance.

   (b) Write in detail about different methods used for treatment of abattoir effluent.

   (c) Give a brief note on the role of 'hurdle technology' in meat preservation. 15+15+10=40

Group-B

6. Answer *any four* of the following: 10×4=40

   (a) Outline the technique for production of hybrid strain of poultry utilising GCA and SCA both.

   (b) What are the objectives and importance of post-mortem inspection of animal carcases?

   (c) Define social class and various social class existed in our society. Mention the difference between social class and caste system in the society.

   (d) Give a brief note on the methods to improve the quality of crop residue.

   (e) Mention the points to be considered for clean milk production.

   (f) Discuss about the factors causing infertility in males.

7. Attempt *any four* of the following: 10×4=40

   (a) What is the importance of buffalo in India and mention few important breeds of buffalo in India.

   (b) Define anoestrus, repeat breeding and silent heat with etiology.

   (c) Assortative mating and its implication in population.

   (d) Give a brief note on the factors responsible for 'Response to selection' and their relationship.

   (e) Describe in brief about the basic requirements for setting up a dairy plant.

   (f) Mention in brief about 'Extension Education Process.'

2021

ANTHROPOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. Discuss the relevance of Linguistic Anthropology in the context of other disciplines in the humanities and social sciences. Briefly state the methods of studying linguistic anthropology. State the distribution of Linguistic families in India with at least two names of representative tribal groups for each linguistic group. 10+10+10=30
2. Discuss the development of Political Anthropology with special emphasis on postmodernism and globalization. State the evolution and structure of Pre-industrial Political Systems. Give a brief account of revitalization movement theory. 10+10+10=30
3. Discuss the importance of Pleistocene epoch in Human evolution. Give an account of the distribution and salient features of Homo erectus fossil remains. Enumerate the different theories of human origin. 10+10+10=30
4. Inbreeding leads to the increase in genetic load – illustrate. Define inbreeding co-efficient and compute the co-efficient of inbreeding of first cousin, second cousin, half sib with suitable pedigree. How knowledge of DNA fingerprinting can be used in personal identification? 10+10+10=30

Group-B

Answer *any three* questions.

5. Define religion and illustrate its functions. Discuss in details the anthropological approaches to study religion. 10+20=30
6. Give an account of the general causes of nutritional deficiency. What are the various ways of measuring nutritional status? Discuss the Protein-Calorie Malnutrition in children with reference to stunting and wasting. 5+10+15=30
7. Define Neolithic. What significant development took place during Neolithic period? Discuss briefly on the Neolithic culture of India. 5+10+15=30
8. Briefly discuss structure and inheritance pattern of mtDNA. Give a short account of the distribution of mtDNA haplotypes of tribal groups of India. 15+15=30

Group-C

9. Write short notes on *any two* of the following: 10+10=20
   (a) Kinship
   (b) Genealogy
   (c) Ethnography
   (d) Economic Anthropology

2021

BOTANY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** or in **Nepali** but all answers must be in one and same language.*

Group-A

Answer *any four* of the following.

1. Write brief notes on *any four* of the following: 10×4=40
   (a) Economic importance of Lichens
   (b) Aeropalynology and its role on human health
   (c) The modes of cellular permineralisation and authigenic preservation of fossils
   (d) Carrying capacity
   (e) Secondary metabolites found in angiosperms
   (f) Types of disease cycles

2. Distinguish between *any four* of the following: 10×4=40
   (a) Alpha and Omega taxonomy
   (b) Transformation and transduction in biology
   (c) Anamorphic and telomorphic fungi
   (d) Homologous and antithetic theory of alternation of generation
   (e) Lytic cycle and Lysogenic cycle
   (f) Centrales and Pennales

3. Explain *any four* of the following: 10×4=40
   (a) Process of double fertilization in angiosperm
   (b) Diagnostic features of Malvaceae and Fabaceae
   (c) Bryophytes in pollution monitoring
   (d) Telome concept
   (e) Parasexuality in fungi
   (f) Phytoremediation

4. Comment on *any four* of the following: 10×4=40

   (a) Melissopalynology

   (b) Stelar types found in plants

   (c) Economic importance of fossils

   (d) Organization of shoot and root apex

   (e) Algal biotechnology

   (f) Mycoproteins

5. Discuss *any four* of the following: 10×4=40

   (a) Secondary growth in *Dracaena* and *Boerhaavia*

   (b) Structure and forms of ovules

   (c) Types of niche in ecology

   (d) Endemism in Indian flora with reference to Sunderbans

   (e) Apospory and apogamy

   (f) Commercial mushroom culture

Group-B

Answer *any two* questions.

6. (a) Discuss the symptoms and disease cycle in 'Late blight of potato'. What are the control measures adapted in the management of this disease? 6+4=10

   (b) What are pathotoxin and phytoalexin? How do they function in disease management of plants? 5+5=10

7. (a) Illustrate the structural features of male and female reproductive parts of *Cycas*. 5+5=10

   (b) Who was the proponent of 'Age and Area' hypothesis? Explain the hypothesis and mention the merits and demerits of the hypothesis. 2+4+4=10

8. (a) Describe with suitable diagrams and development of endosperm in angiosperms. Describe the post fertilization changes in flowers. 6+4=10

   (b) Name economically important plants (2 each) from the family Poaceae, Brassicaceae and Malvaceae. Mention the parts used and economic uses of each. 6+2+2=10

2021

CHEMISTRY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

The figures in the margin indicate full marks for each question.

Answers may be written either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

Section-I

This Section comprises 15 questions in three Groups.
Answer *any ten* questions taking *at least three* questions from each Group.

Group-A

1. Following Bohr model what will be the size of Ne^{9+} ion? Is the size greater than the H-atom? 3+1=4

2. Between Cu(I) chloride and Au(I) chloride which one has higher melting point? Justify your answer. 2+2=4

3. Using VSEPR theory predict the structure of XeF_2 with proper explanation, mentioning the hybrid orbital used by the central atom. 3+1=4

4. An aqueous solution of ammonium acetate reacts neutral to litmus. Why? 4

5. Tl in its 2+ oxidation state is typically unstable. Explain. 4

Group-B

6. Increase of pressure and lowering in temperature may lead to transformation of a gas into liquid. Among these two factors which one do you consider more important and why? 4

7. With an increase in temperature viscosity of a liquid decreases while that of a gas increases — Justify or criticise. 4

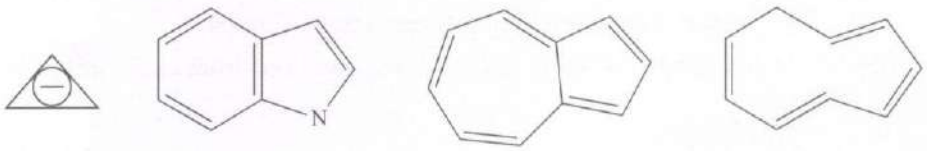
8. With an example write down the steps to convert Weiss indices to Miller indices of a crystal system. 4

9. Draw a model Maxwell's speed distribution curve of a gaseous system and indicate on it the positions of C_m, C_a and C_{rms} where the terms refer to most probable, average and root mean square speeds of the gas. 4

10. Calculate the minimum work needed to prepare 1kg ice from water at 25°C in a refrigerator working between –5°C and 25°C. (Latent heat of fusion of ice = 80 cal g^{-1}.) 4

Group-C

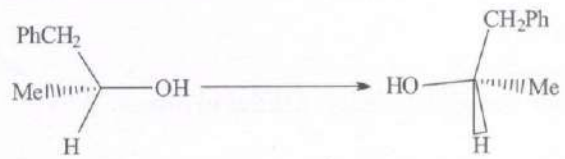
11. Classify the following as aromatic, antiaromatic and nonaromatic. 4



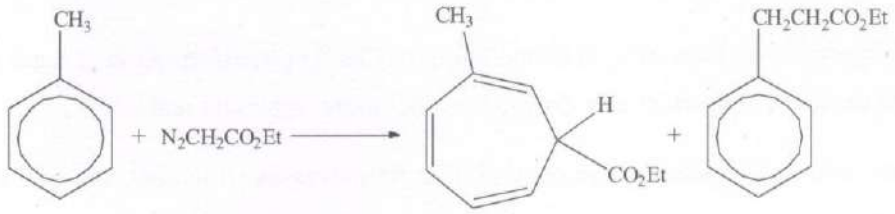
(i) (ii) (iii) (iv)

12. What happens when p-chlorotoluene is treated with $NaNH_2$ in liq. NH_3? 4

13. Carry out following SN^2 substitution reaction. 4



14. Draw the reaction-energy diagram for nitration of benzene. 4

15. 

(A)

Mention the reactive intermediate involved in the formation of "A" and give mechanism. 4

Section-II

This Section comprises *six* questions in three Groups. Answer *any four* questions taking *at least one* question from each Group.

Group-A

1. (a) Given a solution that is 0·5(M) in acetic acid. One litre of this solution is to be diluted to what extent in order to (i) double the pH? (ii) double the $[HO^-]$? (pk_a for acetic acid = 4·74) 5+5=10

   (b) Draw qualitative (approximate) MO energy-level diagram for NO. Is the molecule diamagnetic? What is the bond order in NO? 4+1+1=6

   (c) What is Bent's rule? Discuss with one suitable example. 3+2=5

   (d) What do you mean by a buffer solution? Discuss the mechanism of buffer action. 2+5=7

   (e) State Nernst equation defining each term in it. Discuss with an appropriate example how complex formation affects the redox potential of a redox couple. 2+6=8

   (f) Calculate the pH of an aqueous solution of 10^{-9}(M) HCl. 4

2. (a) What do you mean by crystal lattice energy of an ionic compound? What is Hess's law? In forming the crystal of MgO from Mg(S) and O_2(g), state the steps using Born Haber cycle to estimate the lattice energy of MgO (no numerical values or explanation needed). 2+2+5=9

   (b) 50 ml of 0·1(M) NaCl is titrated with 0·1(M) $AgNO_3$. Calculate the chloride ion concentration during titration (i) when no $AgNO_3$ was added, (ii) after addition of 10 ml $AgNO_3$ and (iii) after addition of 49·9 ml $AgNO_3$. 2+2+2=6

   (c) What is phosphazene? Write down the structure of tetracyclophosphazene. 1+3=4

   (d) Borazine is wrongly called as 'inorganic benzene'. Justify. 6

   (e) For 'particle in an one-dimensional box', state the differential equation for the wave function ψ. What should be the potential energy of the particle outside and inside the box? 2+1+1=4

   (f) Alkaline hydrolysis of CH_3I results in CH_3OH but CF_3I produces CF_3H. Explain. 4

   (g) An electron with charge 'e' and mass 'm' is moving in a circular orbit with average angular velocity ω. Find out the expression for its orbital magnetic moment given that the angular momentum of the electron is $\sqrt{l(l+1)}\frac{h}{2\pi}$ where l is the orbital angular momentum quantum number. 5

(h) The ionic product of water at 95°C is 55 times of that at 25°C. A solution has pH 6·6 at 95°C. Is the solution acidic? Explain. 2

Group-B

3. (a) Coefficient of viscosity of a liquid is often determined by Ostwald viscometry. However, the principal equation in this connection is Poiseuille's equation: $\eta = \pi\Delta pr^4t/8lv$

Where η, Δp, r, l, t and v represent respectively coefficient of viscosity (η), pressure difference (Δp) resulting in the flow of the liquid through the capillary, radius (r) of the capillary, length (l) of the capillary and time (t) required for the flow of a definite volume (v) of liquid.

Relate all these terms with the ones considered during ostwald viscometric experiment. 8

(b) NaCl and KCl crystallizes in the same cubic fashion. However, X-ray diffraction (XRD) study reveals NaCl crystal to be FCC (face centred cubic) and KCl crystal to be SCC (simple cubic crystal). How would you rationalize it. 8

(c) When iodine is partitioned between water and benzene it is observed that the intensity of color in benzene layer is much draker than that in aqueous layer. With the addition of little amount of solid Kl, color of the benzene layer becomes appreciably fade. Justify the phenomenon. Which principle is applied here? 7

(d) In an experiment for determination of surface tension of water by capillary rise method the rise of water in the capillary is found to be 2 cm. If I cut the tube in the middle of it what will happen? 7

(e) $NH_3 + HCl \rightleftharpoons NH_4Cl$

At room or low temperature the forward reaction is spontaneous but at higher temperature the backward reaction is spontaneous — Rationalize from thermodynamic point of view. 10

4. (a) Among the postulates of kinetic theory of gases which two are grossly incorrect for real gases? How have these two issues been taken care of by van der Waals? 2+7=9

(b) Describe the origin of surface tension on a liquid-air interface. Using Langmuir-Blodgett trough (often called Langmuir balance) how can one determine the cross sectional area of a soap molecule? 3+6=9

(c) Among simple cubic crystal (SCC), face centered cubic crystal (FCC) and body centered cubic crystal (BCC) which one is most compact? Establish the order of their relative compactness. 2+8=10

(d) Can an endothermic reaction be spontaneous? Justify your response from thermodynamic point of view. 1+6=7

(e) Give a simple example of an endothermic process. How can one make the process to move in the forward direction more efficiently? 2+3=5

Group-C

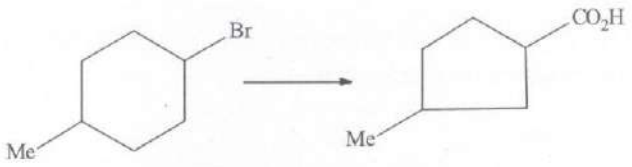
5. (a) The mass spectra two alkyl benzene of molecular formula $C_{10}H_{14}$ show following peaks:

Compound A → B. P. at m/e 91

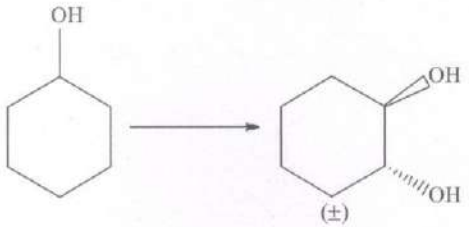
Compound B → B. P. at m/e 105 and a weak peak at m/e 91. Establish the structure of A and B. 5

(b) Carry out following transformation with mechanism. 5+5=10

(i)

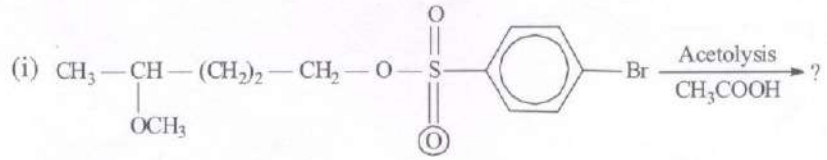


(ii)

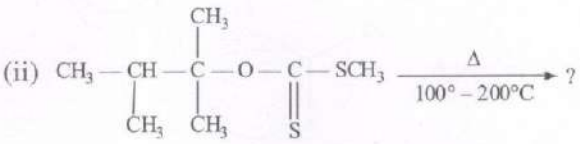


(c) Write the products of the following reaction with mechanism. 5+5+5+5+5=25

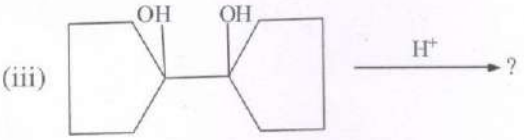
(i)



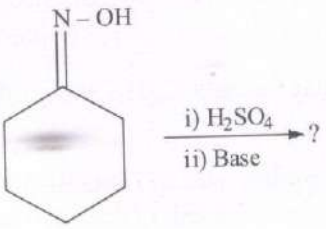
(ii)



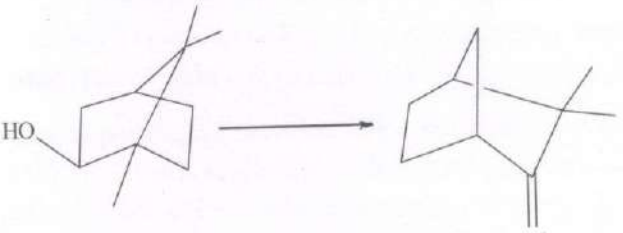
(iii)



(iv)

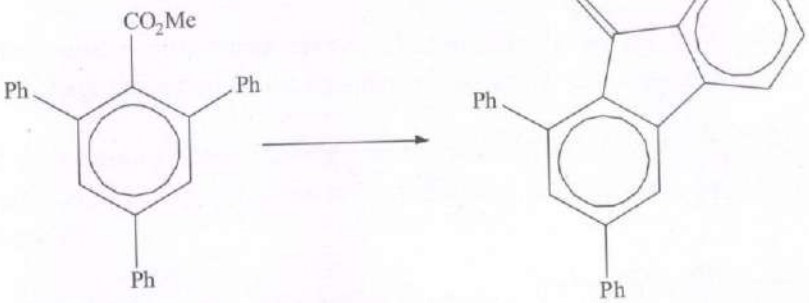
(v) 

6. (a) Carry out following conversion with mechanism. 5+5+5+5=20

(i) 

(ii) PhCHO ⟶ PhCDO

(iii) PhCHO ⟶ 

(iv) 

(b) Explain order of solvolysis of the following compounds. 10

(i) $CH_2 = CH - CH_2Cl$, (ii) Ph CH_2Cl (iii) $MeOCH_2Cl$

(c) When acetone is treated with a base, a liquid compound is formed with b.p. 130°C. Its spectral data are as follows:

UV: λ_{max} 238 nm ε 11700

1R: 1600 cm^{-1}(m), 1595 cm^{-1}(s)

^{1}HNMR: δ 2·1 (6H, s), 6·15(1H, s)

Mass m/e: 55(100), 83(90), 43(78), 98(49), 29(46), 39(43), 27(42), 53(13), 41(13), 28(8).

Deduce the structure of the compound and account for all the observed spectral data. 10

2021

CIVIL ENGINEERING

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in **English** *or in* **Bengali** *but all answers must be in one and the same language.*

All notations / symbols have their usual meanings, unless otherwise specified.

Group-A

Answer *any four* questions. 32×4=128

1. (a) What are the assumptions in Euler's theory of long column? State the relationships between actual length and effective length of columns for different end conditions. 4+3=7

   (b) A mild steel tube, 5 m long, 30 mm internal diameters and 4 mm thick, is used as a strut, with both ends hinged. Find collapse load. Assume $E = 2 \times 10^5$ N/mm^2. 13

   (c) Determine the vertical deflection of the load for the structure shown in Fig. 1. The tension members are stressed to 150 N/mm^2 and the compression members to 80 N/mm^2. Assume $E = 2 \times 10^5$ N/mm^2. 12

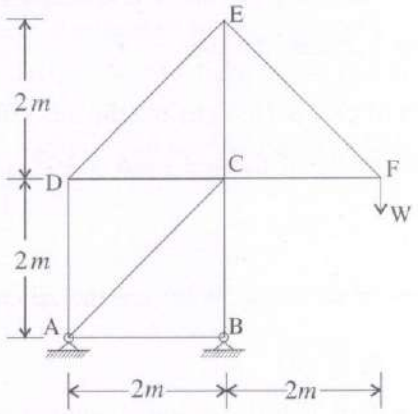


Fig. 1 Structure in Q 1 (c).

2. (a) An undisturbed soil sample was collected in the field in a sampling tube of internal diameter of 5 cm. The length of the extracted soil sample was 10·2 cm and its weight was 387 gm. The specific gravity of soil solids was found to be 2·7 and the weight of dried soil sample was 313 gm. Liquid limit and plastic limit of the soil were determined to be 51% and 20% respectively. Find the porosity, void ratio, degree of saturation, dry density and liquidity index of the soil. 15

(b) State the assumptions made in Boussinesq's solution of vertical stress in soil at a point inside the soil mass due to a vertical concentrated load on surface. 3

(c) Find the expression for vertical stress at a point below the centre of a circular area loaded uniformly at surface. 14

3. (a) What is meant by Influence line diagram for bending moment at any section of a beam? State the uses of such a diagram. 3+4=7

(b) A simply supported girder has a span of 10 m. A 100 kN wheel load moves from one end to the other on the span of the girder. Find the maximum bending moment which can occur at a section at a distance of 4 m from the left hand end. 11

(c) State the conditions for adopting doubly reinforced concrete beam. 5

(d) What is meant by balanced section of a reinforced concrete beam? Differentiate between under reinforced and over reinforced sections. 4+5=9

4. (a) A 20 cm thick specimen of clay takes 20 min to reach 50% consolidation in the laboratory when drained bothways. It the coefficient of volume change is $2{\cdot}5 \times 10^{-2}$ cm^2/kg, evaluate the coefficient of consolidation and the coefficient of permeability of the soil. 7+7=14

(b) Explain the differences between discharge and seepage velocity in flow through porous soils. Find the relation between the two. 5+5=10

(c) Over-dry mass of a pot of clay is 10·8 gm and the mass of mercury displaced on immersion is 84·2 gm. If specific gravity of the soil solid is 2·72, calculate the shrinkage limit of the soil. 8

5. (a) Explain different types of caissons. What are the advantages and disadvantages of open caisson? 3+5=8

(b) The soil at the toe of a dam, is fully saturated and has water content of 40% and specific gravity of soil solids is 2·66. For safety measure against piping, the exit gradient is to be restricted to 30% of critical hydraulic gradient. Find the permissible exit gradient. 8

(c) Explain the slump test for finding the consistency of concrete. Indicate the values of slump for different types of construction. 6+2=8

(d) State the requirements for good concrete. 8

Group-B

Answer *any four* questions. 18×4=72

6. Draw the shear force and bending moment diagram for the loaded beam shown in Fig 2. 18

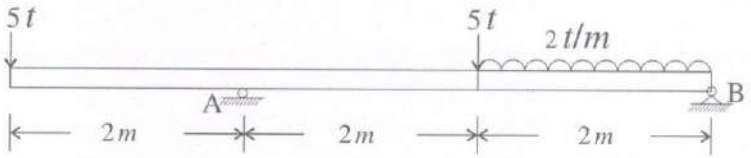


Fig. 2 Beam for Q 6.

7. Foundation for a column consists of a pile group of 4 piles. Arranged in square pattern at a spacing of 1 m c/c. The diameter of the pile is 400 mm and the length of the pile is 12 m. The subsoil consists of clay with q_u = 1·0 kg/cm^2. Assuming γ = 2 gm/c.c, estimate the allowable vertical column load. 18

8. (a) An excavation is to be made in a clay having C = 16 kN/m^2 and $\phi = 0°$. Unit weight of the clay is 18 kN/m^3. What will be the depth of vertical cut that can be made without any support? 9

   (b) If e is void ratio of a soil, S is the degree of saturation, G_s is the specific gravity of soil solids, and w is the water content of the soil, prove that $S.e = G_s.w$. 9

9. An ISA 70 × 70 × 10 is connected to a gusset plate of 15 mm thickness with 14 mm diameter bolts in single row. Determine the maximum tension which the angle section can resist safely. Permissible tensile stress may be assumed to be 1500 kg/cm^2. 18

10. For singly reinforced beams, describe the general requirements for effective span, maximum and minimum reinforcements, spacing of bars and cover to reinforcements. 18

Additional Information:

(a) Salary includes the Proprietor's Salary of ₹ 3,000 for the year.

(b) Suspense A/c of Sri Roy represents a cheque received from him against Sales proceeds of goods sent to him on consignment. Goods costing ₹ 32,500 were sent to him on consignment, $^4/_5$ of the goods was sold by him for ₹ 45,000. He is entitled to a commission at 10% on sale proceeds. The only entry passed in this connection was for the cheque received from him.

(c) Suspense A/c for Smt. Sen represents an advance of ₹ 10,000 to her in connection with a joint venture agreement entered into with her for which she is to get $^2/_5$th share of profit. It is ascertained that the venture has earned a profit of ₹ 7,500.

(d) The security of the schedule on Debtors reveals the following:

(i) ₹ 7,500 — fully realisable

(ii) ₹ 5,000 — 75% realisable

(iii) ₹ 2,500 — 50% realisable

(iv) Provision for Doubtful Debts has to be provided for at 5% on the balance. 10+15+15=40

2. (a) From the following, find out the amount of subscriptions to be included in the Income and Expenditure Account for the year ended 31st March, 2018.

Subscriptions were received during the year 2017-18 as follows:

	(₹)
For the year 2016-17	2,000
For the year 2017-18	30,000
For the year 2018-19	3,000

Subscriptions outstanding as on 31st March, 2017 were ₹ 3,500 out of which ₹ 500 were considered to be irrecoverable. On the same date, subscriptions received in advance for 2017-18 were ₹ 2,000. Subscriptions still outstanding as on 31st March, 2018 amounted to ₹ 6,000.

(b) A firm is willing to change the system of providing for depreciation from diminishing balance method to straight line method with retrospective effect from 1st April, 2015. On 1st April, 2017, machinery account in the ledger had a debit balance of ₹ 5,67,000. The rate of depreciation would, however, remain unchanged. Necessary adjustments for depreciation due to change in method should be made in the year 2017-18. Rate of depreciation 10% p.a. You are informed that new machinery was purchased on 1st October, 2017 at a cost of ₹ 60,000. Show the machinery account from 2015-16 to 2017-18. 20+20=40

Group-B

3. (a) A Ltd. Company invited applications for 10,000 shares of ₹ 10 each at a premium of ₹ 5 per share payable as follows:

On application ₹ 3 per share, on allotment ₹ 6 per share (including premium) and the balance by two calls of equal amount.

Applications were received for 18,000 shares and allotment was made on applications of 15,000 shares at the rate of 2 shares for every 3 applied for. Sen failed to pay the allotment money for the 40 shares allotted to him and these shares were forfeited when he failed to pay the first call. Basu failed to pay the calls in respect of 120 shares allotted to him and these shares were forfeited after the second call.

40 shares allotted to Sen originally and another 40 shares allotted to Basu were later issued to Ghosh as fully paid on payment of ₹ 9 per share.

Show the relevant entries in the Cash Book and Journal of the Company.

(b) The Balance Sheet of Modern Marbels Ltd. as at 31.3.2018 stood as:

Balance Sheet as at 31.3.2018

Liabilities	(₹)	**Assets**	(₹)
Share Capital of ₹ 10 each	50,00,000	Fixed Assets	66,00,000
General Reserve	6,50,000	Investments	18,00,000
Securities Premium	5,40,000	Stock	11,87,000
Profit & Loss A/c	3,75,000	Sundry Debtors	9,60,000
12% Debentures	25,00,000	Cash & Bank Balance	7,10,000
Term Loan	13,25,000		
Current Liabilities & Provisions	8,67,000		
	1,12,57,000		1,12,57,000

The Shareholders adopted the resolution on the date of the above mentioned Balance Sheet to:

(i) Buy Back 20% of the Paid up Capital @ ₹ 15 each.

(ii) Issue 13% Debentures of ₹ 5,00,000 for ₹ 6,50,000 at a Premium of 10% to finance the buy back of shares.

(iii) Maintain a balance of ₹ 3,00,000 in General Reserve Accounts; and

(iv) Sell investment worth of ₹ 8,00,000 for ₹ 6,50,000.

You are required to pass necessary Journal entries to record the above transactions and prepare the Balance Sheet immediately after the buy back. 20+20=40

4. (a) The Balance Sheet of D Ltd. is as follows on 31.12.2017:

Liabilities		(₹)	**Assets**	(₹)
2,500, 6% Preference Shares			Patents	24,000
of ₹ 20 each fully paid		50,000	Buildings	60,000
3,000 Equity Shares of			Cash	500
₹ 20 each, fully paid		60,000	Debtors	12,000
5% Debentures	10,000		Stock	18,000
Add: Interest	2,000		Profit & Loss A/c	15,500
		12,000		
Creditors		8,000		
		1,30,000		1,30,000

The following scheme was passed and sanctioned:

(i) X Ltd. to be formed to take over the business.

(ii) 1 share of ₹ 10 fully paid in the new company to be issued for every 3 equity shares in the old company.

(iii) 3 shares of ₹ 10 fully paid in the new company to be issued for every 5 preference shares in the old company.

(iv) Debenture holders to be discharged in full by X Ltd.

(v) The Creditors to receive 80% of the sums due to them in fully paid shares of ₹ 10 in the new company in full settlement.

(vi) Patents and Profit & Loss Account to be written off.

(vii) Any balance available by the scheme to be used in Writing down Buildings.

Give opening Journal Entries and prepare the initial Balance Sheet of X Ltd.

(b) What is Unrealised Profit on Stock in case of Holding Company? How do you calculate it? Explain the role of AS 21 in this regard. (13+12)+15=40

Group-C

5. (a) M Ltd. furnished the following information in relation to the production of 2,000 units of Product 'N' for the year 2017:

	(₹)
Direct Materials	2,00,000
Direct Labour	1,50,000
Indirect wages (50% fixed)	40,000
Consumable stores (70% variable)	30,000
Office rent (100% fixed)	60,000
Selling expenses (40% variable)	80,000

In the year 2018, it is estimated that the production will increase by 50%. The price of material and labour will go up by 10% and 20% respectively.

You are required to compute Selling Price per unit of Product 'N' for the year 2018 if the Company wishes to maintain profit @ 10% on cost.

(b) From the particulars given below, compute material price variance, material usage variance, labour rate variance, idle time variance and labour efficiency variance with full working details:

1 ton of material input yields a standard output of 1,00,000 units. The standard price of material is ₹ 20 per kg. Number of employees engaged is 200. The standard wage rate per employee per day is ₹ 6. The standard daily output per employee is 100 units. The actual quantity of material used is 10 tones and the actual price paid is ₹ 21 per kg. Actual output obtained is 9,00,000 units. Actual number of days worked is 50 and actual rate of wages paid is ₹ 6·50 per day. Idle time paid for and included in above time is ½ day. 20+20=40

6. (a) The standard time for a job is 60 hours. The hourly rate of guaranteed wages is ₹ 0·75. Because of the saving in time, worker A gets an hourly wage of ₹ 0·90 under Rowan premium bonus system. For the same saving in time, calculate the hourly rate of wages that worker B will get under Halsey-Weir premium bonus system (Assuming 40 percent to workers).

(b) A machine shop contains four newly purchased machines, each occupying practically equal area and costing respectively:

A ₹ 10,000, B ₹ 12,500, C ₹ 15,000 and D ₹ 20,000.

The following are the expenses per annum of the machine shop:

Rent ₹ 5,000; Rates and water ₹ 2,125; Light and heat ₹ 1,575; Power-A ₹ 2,550, B ₹ 2,500, C ₹ 6,000, D ₹ 7,250; Administration ₹ 4,750; Running expenses, Works sundries, Lubricating repairs etc. ₹ 10,000.

Prepare machine hour rate for each machine, assuming 44 hour week, 50 weeks per year, 80% utilisation and the life or machine being 10 years without any scrap value. 20+20=40

Group-D

7. (a) X furnishes the following particulars of his income earned during the previous year relevant to the assessment year 2018-19:

	(₹)
Interest on German Development Bonds ($^2/_5$th is received in India)	60,000
Income from agriculture in Bangladesh, received there but later on ₹ 50,000 is remitted to India (agricultural activity is controlled from Bangladesh)	1,81,000
Income from property in Canada received outside India (₹ 76,000 is used in Canada for meeting educational expenses of X's daughter in USA and ₹ 10,000 is later on remitted to India)	86,000
Income earned from business in Kampala (Uganda) which is controlled from Delhi (₹ 15,000 is received in India)	65,000
Dividend paid by a foreign company but received in India on April 10, 2017	46,500
Past untaxed profit of 2008-09 brought to India in 2017-18	10,43,000
Profit from a business in Madras and managed from outside India	27,000
Profits on sale of a building in India but received in Sri Lanka	14,80,000
Pension from a former employer in India, received in Rangoon	36,000
Gift in foreign currency from a friend received in India on January 20, 2018	80,000

Find out the gross total income of X, if he is (i) resident and ordinarily resident in India, (ii) resident but not ordinarily resident in India or (iii) non-resident in India for the assessment year 2018-19.

(b) For the assessment year 2018-19, X (age: 38 years), an ordinarily resident individual, furnishes the following information:

	(₹)
Income from house property	2,18,500
Business income	1,05,000
Short term Capital gains	4,22,000
Long term Capital gains	2,02,500
Income from owning & maintaining race horses	1,15,000
Income from card games	2,16,000
Besides, X has the following brought forward losses/allowances:	
Brought forward business loss of the A.Y. 2013-14	1,12,000
Unabsorbed depreciation allowance of the A.Y. 2011-12	2,06,000
Long term Capital loss in respect of the A.Y. 2016-17	2,47,200
Brought forward loss from the activity of owning & maintaining race horses for the A.Y. 2015-16	1,25,000
Speculation losses of the A.Y. 2014-15	30,000
Determine the Net income and Tax liability of X for A.Y. 2018-19.	20+20=40

8. Write short notes on: 10×4=40

   (a) Self-assessment (Sec. 140A)

   (b) Agricultural Income

   (c) Deduction in respect of contribution to a National Pension System (Sec. 80 CCD)

   (d) Advance Payment of tax

Group-E

9. Given below are the Balance Sheets of Sigma Ltd. and its subsidiary Addidas Ltd. as on 31.12.2017.

Sigma Ltd. and its subsidiary Addidas Ltd.
Consolidated Balance Sheet
as at 31st December, 2017

Liabilities	Sigma Ltd. (₹)	Addidas Ltd. (₹)	Assets	Sigma Ltd. (₹)	Addidas Ltd. (₹)
Equity Shares of ₹ 100 each	4,00,000	2,00,000	Goodwill	50,000	30,000
10% Pref. Shares of ₹ 100 each	80,000	1,00,000	Machinery	80,000	50,000
General Reserve	80,000	50,000	Vehicles	1,60,000	76,000
Profit & Loss A/c	1,50,000	30,000	Furniture & Fixture	80,000	40,000
Bank Overdraft	30,000	21,000	Investments	2,50,000	45,000
Bills Payable	—	3,000	Stock	50,000	50,000
Sundry Creditors	58,000	56,000	Cash at Bank	57,000	89,000
			Sundry Debtors	70,000	80,000
			Bills Receivable	1,000	—
	7,98,000	4,60,000		7,98,000	4,60,000

The following additional information is available:

(i) Sigma Ltd. acquired 800 Equity shares of Addidas Ltd. on 1.1.2016 and further 700 Equity shares on 1.1.2017 at a cost of ₹ 95,000 and ₹ 85,000 respectively.

(ii) Preference shares of the nominal value of ₹ 30,000 of Addidas Ltd. were acquired by Sigma Ltd. on 1.1.2015 at a cost of ₹ 30,000.

(iii) On 1.1.2017 Profit & Loss A/c of Addidas Ltd. had a Credit balance of ₹ 33,000 and General Reserve of ₹ 20,000.

(iv) Addidas Ltd. had paid dividend @ 10% on the Paid up Capital out of its Profit & Loss A/c balance on 1.1.2017 for the year 2016. The entire dividend received by Sigma Ltd. has been credited to its Profit & Loss A/c.

(v) Bills Receivable of Sigma Ltd. were drawn upon Addidas Ltd. out of which Bills amounting to ₹ 2,000 have been discounted with Bank.

(vi) During the year Sigma Ltd. bought goods from Addidas Ltd. for ₹ 10,000. The amount included a profit of 20% on cost, 40% of these goods remained unsold on 31.12.2017.

(vii) On 1.1.2017 Machinery of Addidas Ltd. were found overvalued by ₹ 10,000 for which necessary adjustments are to be made. The Company charges depreciation @ 10% p.a.

(viii) The management of Sigma Ltd. and Addidas Ltd. wish to recommend a dividend of 15% and 10% respectively, for the year 2017.

Prepare the Consolidated Balance Sheet as on 31.12.2017. 40

10. (a) Beta Ltd. of Kolkata provides the following information for the month of December, 2016:

(i) Purchase of raw materials from the local market (excluding VAT @ 4%) ₹ 80,00,000.

(ii) Half of the goods manufactured from the above materials were exported at a sale price of ₹ 50,00,000.

(iii) Balance goods were given on lease to Mr. Badri of Delhi at a deemed sale price of ₹ 70,00,000 (excluding VAT @ 12·5%).

You may assume that exports are subject to zero rate of tax and input tax credit for raw materials used in the manufacture of leased goods is available immediately.

Compute the amount of Net VAT payable/refund and Input Tax Credit for the month of December, 2016.

(b) Compute the taxable turnover and the tax liability of Mr. Yadav under CST Act assuming that the VAT rate within the state is 4%.

Total inter-state sales during the financial year 2016-17 were ₹ 25,00,000 inclusive of CST.

The sales do not include the following:

(i) Goods worth ₹ 50,000 provided as free samples to Mr. Kamath of Delhi.

(ii) Sale of goods amounting to ₹ 1,50,000 to Mr. Doss, a foreign tourist.

(iii) Despatch of goods worth ₹ 2,00,000 to Mr. Yadav's branch located in another state.

(iv) Hypothecation of goods worth ₹ 12,00,000 for a working capital loan from SBI amounting to ₹ 10,00,000.

(v) State any five purchases eligible for availing input tax credit. (15+15)+10=40

2021

COMPUTER SCIENCE

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Answer *Question No.* 8 and *any six* questions from the rest.

1. (a) What is divide-and-conquer recurrence relation? Give a divide-and-conquer recurrence relation for binary search for an element in a search sequence of size n. 5+10=15

   (b) What are meant by O (n) and Ω (n)? Prove that if

   $f(n) = a_m . n^m + a_{m-1} . n^{m-1} + \cdots + a_1 . n + a_0$, then $f(n) = O(n^m)$.

   Check whether $n \in \Omega(n^2)$ or not. 5+5+5=15

2. (a) State Trapezoidal rule. Also obtain the error formula. Why is it called Trapezoidal rule? 5+10=15

   (b) Find the inverse of the co-efficient matrix of the system $\begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \\ x_3 \end{bmatrix} = \begin{bmatrix} 1 \\ 6 \\ 4 \end{bmatrix}$ by the Gauss-Jordan method with partial pivoting and hence solve the system. 15

3. (a) Describe a full-adder. Give its truth table. Implement it with 2-input NAND gates. 15

   (b) State and prove De Morgan's Laws. Explain how an OR gate may be constructed with AND and NOT gates. 15

4. (a) State and explain

   (i) Kirchhoff's laws,

   (ii) Thevenin's Theorem. 15

   (b) When a circuit is called resonant? Find expression for series-resonant and parallel-resonant circuits. 15

5. (a) Define Recursion. Write a recursive algorithm for obtaining terms of a Fibonacci sequence F. 10

   (b) What is a binary tree? What do you mean by in-order, pre-order and post-order traversals? Explain. Given below the in-order and pre-order traversal strings of a binary tree, reconstruct the binary tree.

   In-order sequence D G B H E A F I C

   Pre-order sequence A B D G E H C F I 8+8+4=20

6. (a) A manufacturer produces two types of models M_1 and M_2. Each M_1 model requires 4 hours of grinding and 2 hours of polishing, whereas each M_2 model requires 2 hours of grinding and 5 hours of polishing. The manufacturer has 2 grinders and 3 polishers. Each grinder works for 40 hours a week and each polisher works for 60 hours a week. Profit on an M_1 model is Rs. 3.00 and on an M_2 model is Rs. 4.00. Whatever is produced in a week is sold in the market. How should the manufacturer allocate his production capacity to the two types of models so that he may make maximum profit in a week? Formulate Mathematically. 20

   (b) Solve graphically the following L.P.P.

   Maximize $z = 3x_1 + 2x_2$

   Subject to the constraints $-2x_1 + x_2 \leq 1$

   $x_1 \leq 2$

   $x_1 + x_2 \leq 3$

   $x_1, x_2 \geq 0$ 10

7. (a) With the aid of diagrams, explain the meaning of the following operational modes of a communication channel.

   (i) simplex (ii) half-duplex (iii) duplex (iv) broadcast (v) multicast (vi) asymmetric and symmetric 20

   (b) Explain what is meant by the term 'data transparency' and how it may be achieved using

   (i) character stuffing,

   (ii) bit stuffing. 4+3+3=10

8. Write short notes on (*any two*): 10×2=20

   (a) Simplex Method

   (b) Karnaugh Map Method

   (c) Newton-Raphson's Method

   (d) Reciprocity theorem

   (e) Modeme

2021

ECONOMICS

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Answer *any five* questions taking *at least two* from each group.

Group-A

1. (a) Explain how negatively sloped convex indifference curves are derived from axioms in a two commodity world.

   (b) Explain the difference between short-run equilibrium and long-run equilibrium in monopolistic competition. 20+20=40

2. (a) How does the competitive firm combine two inputs labour (L) and capital (K) optimally to produce output?

   (b) Discuss the determinants of growth in the AK model of endogenous growth. 20+20=40

3. (a) In an open economy with government, determine the equilibrium output in the goods market.

   (b) In an IS-LM framework, examine the effectiveness of an expansionary fiscal policy on output and interest rate. 20+20=40

4. (a) Draw the indifference map in each of the following cases, clearly indicating the direction in which utility increases:

   (i) Mr. A enjoys both steak and lobster. However, he thinks while steak is good beyond 3 lobsters a day, eating seafood is bad.

   (ii) Mrs. B likes apples but neither likes nor dislikes oranges.

   (iii) Mrs. C thinks automobiles are good but pollution is bad.

   (iv) Mr. D likes tea and always uses two spoons of sugar for one cup of tea.

   (v) Ms. E likes both tea and coffee — they are perfect substitutes for her.

   (b) A profit-maximizing monopolist produces its output with a total cost (in Rupees) function given by

   $$TC = 5Q + 20$$

   and sells its output in two market segments that are completely separated from each other. The demand in market segment 1 and 2 are respectively

   $$Q_1 = 55 - P_1$$

   $$Q_2 = 70 - 2P_2$$

   (i) What quantities should the monopolist sell in each market segment?

   (ii) What prices should be charged in each market segment? (4×5)+(10+10)=40

5. (a) A firm produces output (Q) using labour (L) and machines (K). The following information about the production situation is obtained.

Q	K	L
490	15	99
500	15	100

Q	K	L
470	14	100
500	15	100

The price of L is \$5 per unit and the price of K is \$10 per unit. Does the input combination of 15 units of K and 100 units of L represent the least-cost method of producing output of 500? If not, should the firm use more L and less K, or more K and less L?

(b) The following is information from the national income accounts of a hypothetical country:

GNP = \$2400

Gross Investment = \$400

Net Investment = \$150

Consumption = \$1500

Government purchases of goods and services = \$480

National Income = \$1925

Wages and Salaries = \$1460

Proprietors' income + rental income of persons = \$160

Dividends = \$50

Government budget surplus = \$15

Social insurance contributions = \$190

Net interest income = \$60

Government and business transfers to persons = \$260

Personal tax and non-tax payments = \$300

What is

(i) NNP?

(ii) Net exports?

(iii) Indirect taxes?

(iv) Corporate profits?

(v) Taxes–transfers?

(vi) Personal income?

(vii) Disposable personal income?

(viii) Personal savings? 20+(2½×8)=40

Group-B

6. (a) In a two-country-two-commodity Ricardian model of international trade, show that both countries gain from trade.

   (b) Why is there reference to surplus or deficit in Balance of Payments if Balance of Payments is always in balance? 20+20=40

7. (a) Distinguish between

   (i) Primary deficit and Revenue deficit

   (ii) Public good and Private good.

   (b) While preparing the budget for the country, which type of tax would you prefer to give greater importance to—direct tax or indirect tax? Give reasons for your choice. (10+10)+20=40

8. (a) Find the missing frequency of the following data whose Median is given as 24.

Marks	0–10	10–20	20–30	30–40	40–50
Frequency	13	22	?	16	14

   (b) In shuffling a pack of playing cards, 4 cards are accidentally dropped. Find the probability that the missing cards are one from each suit. 20+20=40

9. (a) Find the mean and standard error of sample proportion for a sample drawn at random with replacement from a finite population.

   (b) In the two-variable Classical Linear Regression model, how would you derive R^2? Explain its significance. 20+20=40

10. Write short notes on *any two*: 20+20=40

   (a) Intra-industry trade

   (b) Cournot model of Oligopoly

   (c) Hypothesis testing

   (d) Expansionary monetary policy in the Mundell-Fleming model with flexible exchange rate and perfect capital mobility.

2021

ELECTRICAL ENGINEERING

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

All symbols have their usual significance.

Group-A

Answer *any three* questions.

1. (a) State and prove the Maximum Power Transfer theorem. Assume impedance load and source impedance.

   (b) A bridge network ABCD is arranged as follows: resistances between terminals A-B, B-C, C-D, D-A and B-D are 10Ω, 30Ω, 15Ω, 20Ω and 40Ω respectively. A 4V battery of negligible resistance is connected between terminals A and C. Determine the value and direction of current in 40Ω resistor.

   (c) Find the Thevenin and Norton equivalents of the circuit (as shown in Fig. 1) at XY terminal.

   10+15+15=40

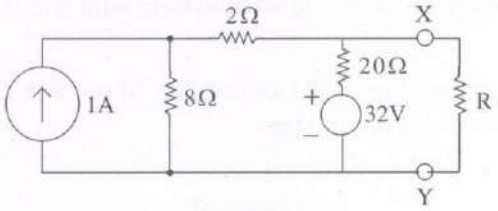


Fig. 1

2. (a) State and explain Biot–Savart's Law.

   (b) Explain Faraday's Laws of electromagnetic induction. Deduce the expression of induced *emf* in a Coil.

   (c) A Coil having an inductance of 60 mH is carrying current of 90A. Calculate the self induced *emf* in the Coil, when the current is (i) reduced to Zero in 0.03 second and (ii) reversed in 0.03 sec. 5+(10+10)+(9+6)=40

3. (a) Explain the theory of Schering Bridge for measurement of capacitance and loss angle. Draw the phasor diagram.

   (b) Two wattmeters are connected to measure the 3-phase power of a balanced system. Determine the power factor of the load when (i) $W_1 = W_2$, (ii) $W_2 = -W_1$, (iii) $W_1 = 2W_2$ and (iv) $W_2 = 0$.

   (c) A Sinusoidal alternating current of frequency 25 Hz has a maximum value of 100A. How long will it take for the current to attain values 20, 50 and 100A? (8+4)+12+16=40

4. (a) Explain the theory of Instrument C.T. Deduce the ratio and phase angle error. Draw the phasor diagram. "C.T. secondary should never be opened"— Justify.

   (b) Calculate the Laplace transform of the periodic pulse train represent by $f(t)$ as shown in Fig.2.

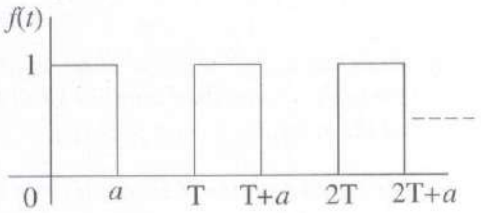


Fig. 2

   (c) Find the (i) average value, (ii) rms value, (iii) form factor and the (iv) peak factor of the square wave as shown in Fig. 3. 18+10+12=40

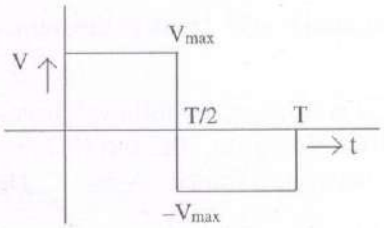


Fig. 3

5. (a) Obtain the time response of a second order system with unit step input with different damping ratio.

   (b) Deduce the transfer function of P-I Controller. Show that the P-I Controller improves the steady state characteristics of the Plant. 20+20=40

Group-B

Answer *any two* questions.

6. (a) Calculate the real and reactive power by the Conjugate method. Justify your calculation.

   (b) Given V = 173.2+j100 Volts and I = 5.0+j8.66 Amps. Find the real power and reactive voltampere by the method of Conjugate. Explain the result.

   (c) State the time domain and frequency domain specification used in Control System. 20+10+10=40

7. (a) Find the overall transfer function of the circuit shown in Fig. 4.

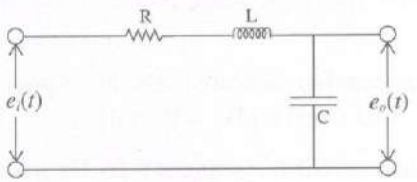


Fig. 4

(b) Using Routh's Stability Criterion, find the range of K for stability of unity feedback system whose characteristic equation is given by

$$S^4+2S^3+2S^2+(3+K)S+K = 0.$$

Also find the value of K for which the system will marginally stable and also the location of imaginary axis poles for this value of K.

(c) The impedances Z_1, Z_2 are connected in parallel across a 100 volts, 50 Hz source.

$Z_1 = 6 + j8$; $Z_2 = 4 - j3$.

Find (i) g_1, b_1, g_2 and b_2,

(ii) Resultant admittance. 10+20+10=40

8. (a) State the drawbacks of standard form of PID Controller. How I-PD Controller overcomes these difficulties?

(b) Explain Ziegler-Nichols methods of tuning of PID regulator for step unit.

(c) Define minimum and non-minimum phase systems. 20+15+5=40

9. Write short notes on the following: 10×4=40

(a) ϕ-factor at resonance

(b) Bandwidth

(c) Z-transform

(d) Transport lag

2021

GEOGRAPHY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

Illustrate your answers with suitable diagrams/ sketches.

Answer any five *questions, taking at least* two *from each group.*

Group-A

1. Examine the various processes involved in chemical weathering. Indicate their role in bringing about topographic changes. Discuss the differences between 'cyclic' and 'non-cyclic' concepts of landform evolution. 10+10+20=40

2. Discuss the basis of classification of world climate after Köppen. Comment on the merits and demerits of this classification. What is the importance of the ozone layer? Explain the processes of its formation and depletion. 10+10+5+15=40

3. Give a detailed account of the Mid Oceanic Ridge System. What are the major solutes in sea water? Explain the characteristics of biogenous ocean sediments. 15+10+15=40

4. Explain biogeochemical cycle with the help of nitrogen cycle as an example. Analyse the impact of deforestation on the slopes of semi-arid area and on mangrove-covered delta region. 20+20=40

5. What are the principle, properties and uses of polar zenithal projections? Discuss in detail how the electromagnetic radiation (EMR) interacts with the atmosphere. How can RS and GIS be used for hazard management? 20+10+10=40

Group-B

6. Elucidate the major characteristics of intensive subsistence agriculture focussing on the physical and cultural elements, crop pattern and farm layout. Examine the role of physical and economic factors in the development of commercial fishing with particular reference to their areas of concentration. 20+20=40

7. Discuss the factors that determine the population density of a region. How does literacy affect the birth rate of a country? What do you mean by 'population composition'? 20+15+5=40

8. Explain the social process of adaptation and assimilation with examples. How are the tribes vulnerable to social discrimination? Differentiate frontiers from boundaries. 15+15+10=40

9. Critically analyse the theory of urban growth as put forward by Homar Hoyte. What is meant by the term "urban hierarchy"? State the assumptions on the basis of which Christaller formulated the "Central Place Theory." 20+5+15=40

10. Elaborate the concept of region. Distinguish between formal and functional region. Explain the characteristics of "State" as a planning region. 10+10+20=40

2021

GEOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. (a) Illustrate with neat sketches different types of volcanoes and their distribution in relation to plate boundaries.

   (b) What is an Unconformity? How it is recognized? Describe briefly the different types of Unconformities.

   (c) What is Palaeomagnetic Reversal? 15+15+10=40

2. (a) Explain the following with diagrams:

   (i) Anticline and Syncline

   (ii) Fold axis

   (iii) Axial plane of a fold

   (iv) Plunge of an antiform.

   (b) Define a fault. Illustrate with neat sketches different types of faults. How do you identify faults in the field? (5×4)+20=40

3. (a) What is a dam and what is its utility? Give an account on the classification of dams based on the types of materials used in their construction.

   (b) Explain the following:

   (i) Geosynchronous and Sun synchronous satellites.

   (ii) Different types of sensors used by Indian Remote Sensing Satellites.

   (iii) Scanning systems of Remote Sensing Satellites.

   (c) Discuss the causes of landslides. 15+(5×3)+10=40

4. (a) What are the different types of meteorites? Discuss the significance of meteorite study in Geology.

   (b) How is gravitation different from gravity? What is Free-air correction? What is gravity anomaly?

   (c) Describe the different types of seismic waves generated in an earthquake. 15+15+10=40

5. (a) What are aquifers? Explain the different types of aquifers and their characteristics with suitable diagrams.

   (b) Define porosity and permeability of a rock. Distinguish between 'Specific Yield' and 'Specific Retention'. How are they related to porosity of an aquifer?

   (c) Comment briefly on rainwater harvesting. 15+15+10=40

Group-B

Answer *any two* questions.

6. (a) Describe with neat sketches the hard part morphology of gastropoda.

   (b) Why is stratigraphic correlation comparatively easier in the Phanerozoic than in the Precambrian successions? 20+20=40

7. (a) Briefly discuss the main elements of Siwalik vertebrate fauna and give their stratigraphic distribution.

   (b) Write notes on *any two* of the following:

   (i) Cretaceous succession of Trichinopoly

   (ii) Iron ore Group

   (iii) Chronostratigraphic correlation 20+(10×2)=40

8. (a) Discuss the stratigraphic importance of

   (i) Ptilophyllum flora

   (ii) Syringothyris cuspidata

   (iii) Globotruncana

   (iv) Gondwana flora

   (b) Give an account of the stratigraphic development of the Vindhyan Supergroup. (5×4)+20=40

2021

HISTORY

PAPER-I

Time Allowed—3 Hours *Full Marks—200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

1. Answer *any three* questions: 10×3=30

   (a) Why are the foreign accounts of India useful for the writing of Indian History?

   (b) Discuss the geographical extent and town planning of the Harappan civilization.

   (c) How far Asoka was responsible for the downfall of the Mauryan empire?

   (d) Write a short note on Gandhara Art.

2. Answer *any two* questions: 20×2=40

   (a) Write briefly about the expansion of the foreign trade in the reign of Satavahana.

   (b) Review the cultural progress of the ancient India in the Gupta period.

   (c) Write a short note on urbanization in Ancient India.

3. Answer *any one* question: 30×1=30

   (a) Write an essay on origin and development of feudalism in Ancient India.

   (b) Discuss briefly the condition of women in Ancient India from Vedic age to Gupta age.

Group-B

4. Answer *any three* questions: 10×3=30

   (a) Write a short note on the land revenue system of Alauddin Khilji.

   (b) Was the Delhi Sultanate a theocratic state?

   (c) Discuss briefly the achievements of Mahmud Gawan as a maker of Bahmani kingdom.

   (d) Discuss the main features of India's commercial contacts with South-East Asia in early Medieval India.

5. Answer *any two* questions: 20×2=40

   (a) Review the impact of Bhakti movement on Indian society.

   (b) Critically discuss the economic condition of Vijaynagar empire.

   (c) Discuss the major architectural achievements of the Sultanate period.

6. Answer *any one* question: 30×1=30

   (a) Write an essay on the consolidation of the Mughal empire under Akbar.

   (b) Make an overview upon the social life under the Mughals.

2021

LAW

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be written either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

Group-A

Answer *any three* questions.

1. (a) Define 'State' under Article 12 of the Constitution of India with case law.

   (b) Write a critical note on freedom of speech and expression and reasonable restrictions thereon as laid down in the Constitution of India. 20+20=40

2. (a) Discuss the doctrine of basic structure with landmark judgements of the Apex Court.

   (b) Discuss the various procedure of amendment of the Constitution of India. 20+20=40

3. (a) State in brief about various rights to freedom guaranteed under the Constitution of India.

   (b) Write a critical note on cultural and educational rights under the Constitution of India. 20+20=40

4. (a) What are the fundamental duties recognised in India? Explain its contemporary relevance.

   (b) Discuss the relation between fundamental rights and fundamental duties under the Constitution of India. 20+20=40

5. (a) Discuss the constitutional status regarding the right to property in India.

   (b) Discuss the law relating to dismissal, removal or reduction in rank of persons employed in civil capacities under the Union or a State under the Constitution of India. 20+20=40

6. Write short notes on *any two* of the following: 20×2=40

   (a) Proclamation of Emergency

   (b) Protection of international Peace and Security

   (c) Uniform Civil Code for the citizens of India

   (d) Distribution of legislative powers as laid down in the Constitution of India

Group-B

Answer *any one* question.

7. (a) Discuss the relation between international law and municipal law.
   (b) Discuss the sources of international law. 20+20=40

8. (a) Write a note on human rights under international law.
   (b) Discuss various theories of international human rights law. 20+20=40

Group-C

Answer *any one* question.

9. (a) Write an essay on Kelson's Pure theory of law.
   (b) Discuss the various facets of custom as a source of law. 20+20=40

10. (a) Discuss the relation between possession and ownership.
    (b) Discuss the Austin's theory of law. 20+20=40

2021

MANAGEMENT

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. (a) Discuss Max Weber's management principles and its relevance in specific organisations in contemporary times.

   (b) State the managerial functions and the corresponding managerial roles as propounded by Mintzberg. 20+20=40

2. (a) Businesses may need to adapt their policies and strategies to changing times in order to stay competitive. Explain what changes may be needed to rethink their business objective in view of the experiences gained in Covid 19.

   (b) Differentiate between

   (i) standing plans and programmes,

   (ii) tactical and operational strategies. 20+10+10=40

3. (a) List and deliberate on the steps in decision making process.

   (b) Describe, in short, the different methods used in decision making under certainty, under uncertainty and under risk. 10+30=40

4. (a) Draw a hypothetical organisation chart with 4 hierarchical layers, 3 line managerial functional departments and one staff department.

   (b) Explain the concepts of line and staff, delegation and decentralisation of authority using the diagram or otherwise. 20+20=40

5. (a) Control is the essence of planning. Discuss the statement.

   (b) Distinguish between intrinsic and extrinsic motivation and its relevance for each managerial level.

   (c) Explain how interrelations between power, authority and feedback have strong effect on managerial effectiveness. 10+20+10=40

Group-B

Answer *any two* questions.

6. (a) Discuss the theory behind Kurt Lewin's model of change.

   (b) According to Lewin, what is the process that should be followed to implement organisational change? 20+20=40

7. (a) Define Personality. Outline the factors influencing personality of an individual.

   (b) Critically discuss the Big Five theory of personality. 15+25=40

8. (a) Differentiate between groups and teams.

   (b) Explain the process of group formation, outlining the hindrances in it and how can they be overcome to form effective groups? 10+30=40

9. Write short notes on *any four*: 10×4=40

   (a) Reverse engineering

   (b) Six Sigma

   (c) Business Excellence models

   (d) Enterprise resource planning

   (e) Management information system

2021

MATHEMATICS

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

1. Answer *any two* questions: 10×2=20

   (a) If $U(F)$ and $V(F)$ are two vector spaces and T_1, T_2 are linear transformations from U into V, prove that the mapping T defined by $T(\alpha)=CT_1(\alpha)+T_2(\alpha), \alpha \in U, C \in F$ is a linear transformation from U into V.

   (b) Let V be the vector space of all 2×2 matrices over the field F. Prove that V has dimension 4 by exhibiting a basis for V which has 4 elements.

   (c) Reduce the matrix A to row-reduced echelon form and hence find its rank, where

$$A=\begin{bmatrix} 0 & 1 & -3 & -1 \\ 1 & 0 & 1 & 1 \\ 3 & 1 & 0 & 2 \\ 1 & 1 & -2 & 0 \end{bmatrix}.$$

2. Answer *any two* questions: 10×2=20

   (a) Let $0 < x_0 < 1$ and $x_{n+1}=\dfrac{1}{1+x_n}$ for all $n \geq 0$. Prove that $\{x_n\}_n$ converges.

   (b) If $\underset{x \to 0}{\text{Lt}} \dfrac{\sin 2x + a \sin x}{x^3}$ be finite, find the value of 'a' and the limit.

   (c) Discuss the applicability of the Mean Value Theorem $f(b)-f(a)=(b-a)f'(\xi)$, $a < \xi < b$. Also find ξ, where $f(x)=x(x-1)(x-3)$, $0 \leq x \leq 4$.

3. Answer *any two* questions: 10×2=20

   (a) Let $f: S \to R$, $(S \subset R)$, be continuous on S and S be a compact set. Then prove that $f(S)$ is a compact set.

   (b) Show that $\int_1^{\infty} \dfrac{\sin x}{x^p} dx$ converges for $p > 0$.

   (c) Develop $f(x)$ in Fourier series on $-\pi < x < \pi$ if

$$f(x)=0, \text{ for } -\pi < x < 0$$
$$=\pi, \text{ for } 0 < x < \pi.$$

4. Answer *any two* questions: 10×2=20

(a) A function $f(x)$ is defined on [0, 1] by $f(x)=\begin{cases} x, & \text{when } x \text{ is rational} \\ 0, & \text{when } x \text{ is irrational.} \end{cases}$

Find the upper and lower integral sums corresponding to the partition P_n of $0 \le x \le 1$ into n equal partial intervals by points $\left\{0, \frac{1}{n}, \frac{2}{n}, \cdots, \frac{r}{n}, \cdots, \frac{n}{n}\right\}$; hence evaluate I and J and show that $f(x)$ is not integrable on [0, 1].

(b) Show that the series $x^4 + \frac{x^4}{1+x^4} + \frac{x^4}{(1+x^4)^2} + \frac{x^4}{(1+x^4)^3} + \cdots$ is not uniformly convergent on [0, 1].

(c) If $y = 2\cos x(\sin x - \cos x)$, show that $(y_{10})_0 = 2^{10}$.

5. Answer *any two* questions: 10×2=20

(a) If the line $ax^2 + 2hxy + by^2 = 0$ be two sides of a parallelogram and the line $lx + my = 1$ be one of its diagonal, show that the equation of the other diagonal is $y(bl - hm) = x(am - hl)$.

(b) If the normal to the hyperbola $xy = c^2$ at the point $\left(ct_1, \frac{c}{t_1}\right)$ meets the curve again at the point $\left(ct_2, \frac{c}{t_2}\right)$, then show that $t_1^3 t_2 + 1 = 0$.

(c) Reduce the equation $x^2 + 4xy + y^2 - 2x + 2y + 6 = 0$ to its canonical form and determine the nature of the conic.

6. Answer *any two* questions: 10×2=20

(a) Show that the locus of a point which is equidistant from two given straight lines $y = mx, z = c$ and $y = -mx, z = -c$ is $mxy + c(1 + m^2)z = 0$.

(b) Show that the feet of the normals from the point (α, β, γ) to the ellipsoid $\frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ lie on the surface $\frac{\alpha a^2(b^2 - c^2)}{x} + \frac{\beta b^2(c^2 - a^2)}{y} + \frac{\gamma c^2(a^2 - b^2)}{z} = 0$.

(c) Reduce the equation $x^2 + y^2 + z^2 - 2yz + 2zx - 2yx + x - 4y + z + 1 = 0$, to its canonical form and determine the type of the quadric represented by it.

7. Answer *any two* questions: 10×2=20

(a) Solve : $(x - y^2)\,dx + 2xy\,dy = 0$

(b) Solve : $(D^2 - 3D + 2)\,y = \cos 3x$

(c) Find the orthogonal trajectory of the family of curves $x^{2/3} + y^{2/3} = a^{2/3}$.

8. Answer *any two* questions: 10×2=20

(a) Solve : $\sin x\frac{d^2y}{dx^2}-\cos x\frac{dy}{dx}+2y\sin x=0$

(b) Solve by using Laplace transform, the equations $(D-2)x+3y=0$, $2x+(D-1)y=0$, $t>0$ and $D\equiv\frac{d}{dt}$ given that $x(0)=8$ and $y(0)=3$.

(c) Solve : $(x^2-yz)\,p+(y^2-zx)\,q=(z^2-xy)$, where $p=\frac{\partial z}{\partial x}$ and $q=\frac{\partial z}{\partial y}$.

9. Answer *any two* questions: 10×2=20

(a) Forces X, Y, Z act along the three straight lines $y=b$, $z=-c$; $z=c$, $x=-a$; $x=a$, $y=-b$ respectively. Show that they will have a single resultant at $\frac{a}{X}+\frac{b}{Y}+\frac{c}{Z}=0$.

(b) A hemispherical shell on a rough plane, whose angle of friction is λ, show that the inclination of the plane base of the rim to the horizontal cannot be greater than $\sin^{-1}(2\sin\lambda)$.

(c) The moments of a system of forces about the points $(0, 0)$, $(a, 0)$, $(0, a)$ are $a\omega$, $2a\omega$, $3a\omega$ respectively. Find the components of their resultant parallel to the coordinate axes and the equation to its line of action.

10. Answer *any two* questions: 10×2=20

(a) A particle moves from rest in a straight line under an attractive force $\mu\times(\text{distance})^{-2}$ per unit mass to a fixed point on the line. Show that if the initial distance from the centre of force be $2a$, then the distance will be a after a time $\left(\frac{\pi}{2}+1\right)\left(\frac{a^3}{\mu}\right)^{1/2}$.

(b) A body is projected horizontally from a point on the earth's surface with velocity $\sqrt{1{\cdot}5Rg}$, R being the earth's radius. What will be its maximum distance from the earth's centre?

(c) A particle describes the equiangular spiral $r=ae^{\theta}$ in such a manner that the radial acceleration is zero. Prove that the speed and the magnitude of acceleration are each proportional to r.

2021

MECHANICAL ENGINEERING

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Answer any five *questions.*

1. Answer the following:

   (a) Consider the single degree of freedom system as shown in Figure 1. The coulomb friction is present between the block and the surface. Obtain the equation of motion for the mass. Determine the equation for the amplitude decay of the oscillation for this system. Assume that coefficient of static friction and coefficient of kinetic friction are equal. The spring is massless.

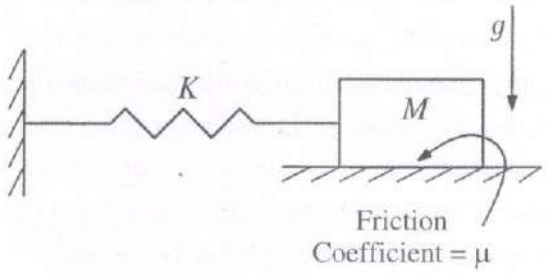


Figure 1: A single degree of freedom system with coulomb friction.

   (b) A single degree of freedom system is shown in Figure 2. The dashpot and the spring are massless. Find the frequency of the base excitation (ω) for which the displacement transmissibility is independent of the damping coefficient C.

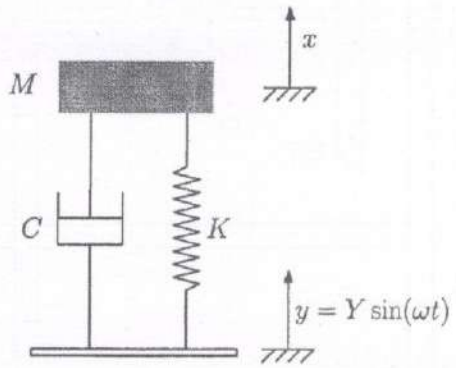


Figure 2: A spring-mass-damper (viscous) system undergoing a harmonic base excitation.

(c) Determine the effect of the mass of the spring on the natural frequency of the system shown in Figure 3. The length of the spring is L. Write down the necessary assumptions.

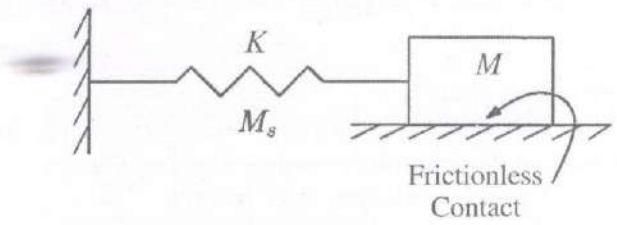


Figure 3: A single degree of freedom system with the spring having the mass = M_s.

15+10+15=40

2. Answer the following:

(a) For the gear train shown in the Figure 4, the shaft-A rotates at 100 rpm in the anti-clockwise direction as seen from your (reader's) right side. Determine the direction of rotation and the angular velocity of the shaft-B. The number of teeth corresponding to each gear is mentioned beside the gear of interest. For example gear-7 has 59 teeth. The other relevant information are listed below:

- Gear-5 and Gear-6 are rigidly connected to each other. Gear-7 and Gear-8 are rigidly connected to each other.
- Dotted lines imply that the gear can freely rotate about the shaft on which it is mounted. For example the gear-8 can freely rotate about the shaft-B. Similarly the gear-6 can freely rotate about the arm.
- Gear-2 and Gear-9 are keyed to the shaft-A. Gear-3 and Gear-4 are keyed to the shaft-C.
- The elements numbered as '1' are the fixed elements.

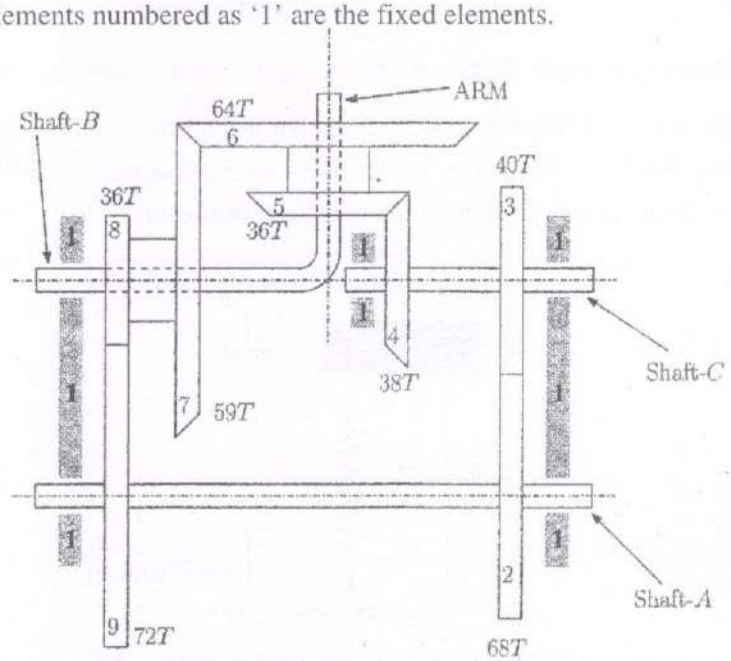


Figure 4: The schematic of a gear train.

(b) A pinion and a gear are in mesh. Both are spur gears. Obtain the expression for the minimum number of teeth on the pinion to avoid involute interference. 20+20=40

3. Answer the following:

(a) Find the deflection of the cantilever beam (Figure 5) at the point of application of the force P. The spring is unstretched when the beam is horizontal.

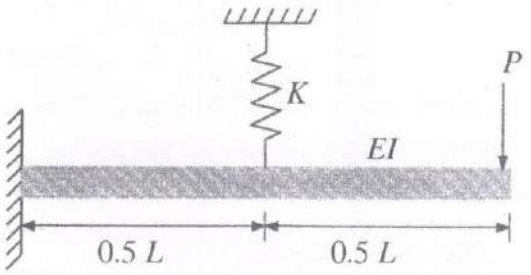


Figure 5: A cantilever beam with a spring connected at the middle.

(b) A couple of M = 70 N-m (about the longitudinal axis of the shaft and anti-clockwise as seen from the right) is applied to a 25 mm diameter aluminium-alloy shaft as shown in Figure 6. The ends A and C are built-in and prevented from rotating. Determine the angle through which the centre cross section O rotates. The shear modulus of the aluminium-alloy is 28 GPa.

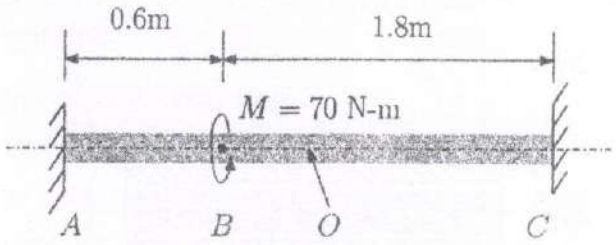


Figure 6: A circular shaft subjected to a couple about its longitudinal axis.

20+20=40

4. Answer the following:

(a) Find the elastic buckling load for the system shown in Figure 7.

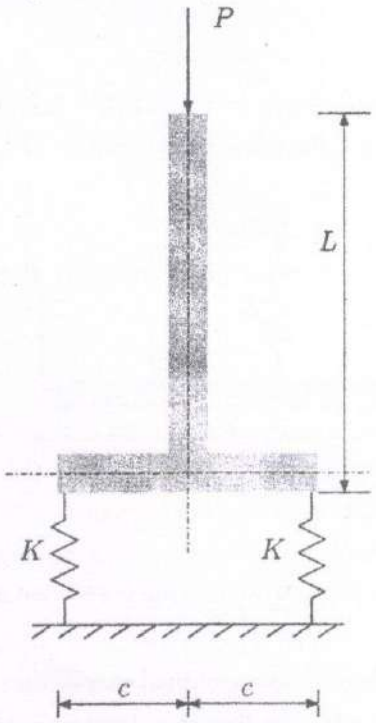


Figure 7: A rigid inverted 'T' structure supported on two linear springs.

(b) A cold-rolled steel bolt passes through a hard-drawn copper tube as shown in Figure 8 and the nut at the left end is turned up just snug. Subsequently the nut is tightened up $n = \frac{1}{4}$ turn. Determine the values of the stresses generated in the bolt and tube under this condition. The cross sectional area of the steel bolt is $A_s = 3$ cm^2, its modulus of elasticity is $E_s = 210$ GPa. For the copper tube, $A_c = 4$ cm^2 and $E_c = 120$ GPa. The pitch of the single-start thread is $p = 3$ mm.

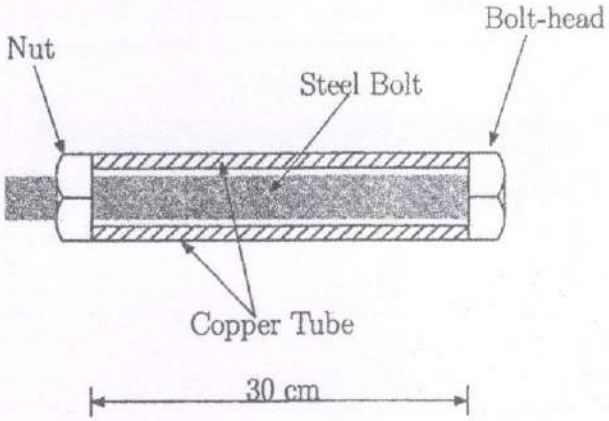


Figure 8: The steel bolt and copper tube assembly.

20+20=40

5. Answer the following:

   (a) The firing order of a two-stroke six-cylinder diesel engine is I-V-III-VI-II-IV. The adjacent cylinder centrelines are 75 cm apart. Each cylinder has a connecting rod 120 cm long and a stroke 45 cm. The mass of the reciprocating parts in each cylinder is 200 kg. Determine the magnitude of the primary and secondary unbalanced forces and moments when the engine runs at a constant speed of 250 rpm.

   (b) How does the train turn without the differential? 30+10=40

6. Answer the following:

   (a) A hole of 10 mm diameter is drilled in a steel block of 20 mm thickness. In the drilling operation, it is observed that the tool life decreased from 40 min to 10 min due to increase in drill speed from 300 rpm to 600 rpm. What will be the tool life of that tool under the same condition if the drill speed is 400 rpm?

   (b) The manager of a restaurant wants to forecast demand of pizzas based on exponential smoothing method. For the past three months, demand for pizzas has been as shown in the table below:

Month	Actual Demand
June	100
July	25
August	77

   If the forecast for the month of June was 50, estimate the forecast for the month of September using Exponential smoothing method (assume smoothing coefficient = 0·20). What do you think about a 0·20 smoothing constant? 20+20=40

7. Answer the following:

   (a) What do you mean by break-even analysis? For a particular product, the following information is given:

   - Selling price per unit = Rs. 200,
   - Variable cost per unit = Rs. 50 and
   - Fixed costs = Rs. 1,00,000.

   Calculate the break-even points in terms of units and sales. Suppose due to inflation the variable cost per unit has increased by 20% while fixed costs remained same. If the break-even quantity is to remain constant by what percentage should the sales price be raised?

   (b) What are the different methods suitable for making through holes of diameter around 2 mm in a 2 mm thick glass plate? State briefly the working principle of laser beam machining (LBM). 20+20=40

8. Answer the following:

(a) The project activities, precedence relationships and durations are described in the table. Draw the CPM network for the activities and find the critical path. Also, calculate the total float of all the activities.

Activity	Precedence	Duration (in hours)
A	–	3
B	A	4
C	A	2
D	B	5
E	C	1
F	C	2
G	D, E	4
H	F, G	3

(b) Describe the working principle of metal removal in Plasma Arc Machining (PAM) process with the help of sketch. 20+20=40

2021

PHILOSOPHY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Answer *any five* questions taking at least *two* from each group.

Group-A

1. Discuss Plato's theory of Ideas. How does Aristotle react to this? 25+15=40

2. Explain and examine Spinoza's view of substance. 25+15=40

3. (a) What does Kant mean by 'pure intuition'?

   (b) Discuss, according to Kant, the metaphysical exposition of both space and time.

   10+(15+15)=40

4. Write short notes on *any two* of the following: 20×2=40

   (a) Hume's scepticism

   (b) Kant's distinction between analytic and synthetic judgements

   (c) Moore's refutation of idealism

   (d) Wittgenstein's picture theory of meaning

Group-B

5. Discuss the Cārvāka theory of reality. Explain, in this context, the relation between metaphysics and ethics according to the Cārvāka philosophy. 20+20=40

6. Explain and examine the Nyāya theory of self. 25+15=40

7. How does Śaṅkara develop his doctrine of Māyā? On what grounds does Rāmānuja refute this doctrine? 20+20=40

8. Write short notes on *any two* of the following: 20×2=40

   (a) Nyāya concept of *Vyāpti*

   (b) Sāṅkhya theory of causation

   (c) 'Integral Yoga' in Aurobindo's philosophy

   (d) Tagore's concept of 'Surplus Man'

2021

PHYSICS

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. (a) A particle of mass m travels in a medium along a horizontal linear path. The initial velocity is v_0 and the viscous force acting on it is proportional to its instantaneous velocity. In absence of any other forces, find the velocity of the particle as a function of time.

   (b) Differentiate between inertial and non-inertial frames of reference. A particle is thrown vertically upwards with a velocity v_0 at a place of latitude λ. Show that the particle shifts a distance $\frac{4\omega v_0^3}{3g^2}\cos\lambda$ westward from the original position, where the symbols have their usual meanings.

   (c) Two particles of masses m_1 and m_2 are placed at a distance x apart. Show that at a point where the gravitational field due to two particles is zero, the gravitational potential is given be

   $$V = -\frac{G}{x}(m_1 + m_2 + 2\sqrt{m_1 m_2})$$

   (d) Show that the kinetic energy of a system of particles is equal to the kinetic energy of a single particle of total mass M situated at the centre of mass, together with kinetic energy of the system of particles with their motion relative to the centre of mass.

   (e) A particle moving under a central force describes spiral orbit given by $r = a\exp(b\theta)$, where a and b are constants. Obtain the force law. [6+(4+8)+8+6+8]=40

2. (a) Set up the Lagrangian for the simple pendulum and obtain an equation describing its motion.

   (b) A particle of mass m is dropped into a tunnel drilled along a diameter through a planet of mass M and radius R and of uniform density. Show that the motion of the particle is simple harmonic and also determine its period.

   (c) Show that a shear is equivalent to an equal elongation and a compression at right angles to each other.

   (d) If a number of droplets of water, all of the same radius r cm, coalesce to form a single drop of radius R cm, show that the rise in temperature will be given by $\frac{3S}{J}\left(\frac{1}{r} - \frac{1}{R}\right)$, where S is the surface tension of water and J is Joule's mechanical equivalent of heat.

   (e) Write down the equation of continuity for an ideal fluid of density ρ. Use Poiseuille's formula to show that if two capillary tubes of radii r_1, r_2 and lengths l_1, l_2 respectively are connected in series, the rate of flow V is given by

   $$V = \frac{\pi p}{8\eta}\left(\frac{l_1}{r_1^4} + \frac{l_2}{r_2^4}\right)^{-1}$$ [8+8+8+8+(2+6)]=40

3. (a) Describe briefly Michelson-Morley experiment with a suitable sketch and discuss its significance.

   (b) An observer on a railway platform sees two trains approaching each other with speeds v_1 and v_2. He finds that adding v_1 and v_2 gives $\frac{7}{5}c$. An observer on one train sees the other train approaching him with a speed of $\frac{35}{37}c$. What are the velocities of the trains relative to the observer on the platform?

   (c) Derive an expression for the relativistic kinetic energy of a body. Show that it reduces to classical value $\frac{1}{2}m_0v^2$ for small velocities($v << c$).

   (d) Derive expressions for the moment of inertia of a circular disc of mass M and radius r about (i) an axis perpendicular to its plane, passing through the centre and about (ii) a tangent perpendicular to its plane.

   (e) Prove that for a homogeneous and isotropic medium $Y = 3K(1 - 2\sigma)$, where Y denotes Young's modulus, K Bulk modulus and σ Poisson's ratio. [8+8+(6+2)+(4+4)+8]=40

4. (a) Two sources of intensities $4I$ and I are used in an interference experiment. Obtain the intensities at points where the waves from the two sources superpose with a phase difference of (i) zero and (ii) π. Show that conservation of energy is not violated in the interference pattern.

   (b) What is a plane diffraction grating? How many orders would be visible if the wavelength of incident light is 589 *nm* and the number of lines in the grating is 100/*mm*?

   (c) Explain Brewster's law. Use this law to show that when light is incident at the polarising angle, the reflected and refracted rays are at right angles.

   (d) Show that the ratio

   $$\frac{A_{21}}{B_{21}} = \frac{8\pi h\nu^3}{C^3}$$

   where A's and B's are the Einstein's A and B coefficients and the other symbols have their usual meanings.

   (e) A pendulum of length l with a bob of mass m at its end is moving through oil. The bob undergoes small oscillations, but the oil retards the bob's motion with a resistive force $F_{res} = 2m\sqrt{\frac{g}{l}}(l\dot{\theta})$, where θ is the angular displacement of the pendulum. The bob is initially pulled back at $t = 0$ with $\theta = \alpha$ and $\dot{\theta} = 0$. Find the angular displacement θ as a function of time. [(5+5)+(2+4)+(2+4)+10+8]=40

5. (a) Use Gauss's law to calculate electric field intensity due to a spherical charge distribution, given by

   $$\rho = \rho_0\left(1 - \frac{r}{a}\right), \text{when } r \le a$$
   $$= 0, \qquad \text{when } r > a$$

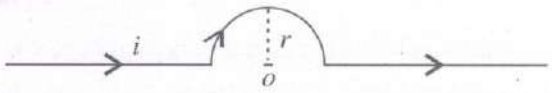
   Find also the value of r for which field is maximum.

   (b) Two equal charges $+q$ are placed a distance d apart in front of an infinite earthed conducting plane such that each charge is at a distance $\frac{d}{2}$ from the plane. Show that the force on each charge is of magnitude $\frac{3q^2}{8\pi\epsilon_0 d^2}$.

   (c) A short electric dipole of dipole moment p_1 is placed in an electric field of another dipole of dipole moment p_2 at a distance d from it. Calculate the force and torque that p_1 experiences when both the dipoles are pointing along the lines joining them.

(d) Apply Kirchhoff's laws to find the current through the galvanometer in an unbalanced Wheatstone bridge. Hence find the condition for balance.

(e) A long wire having a semi-circular loop of radius r carries a current i as shown in the figure. Use Biot-Savart law to find the magnetic induction at the centre O due to the entire wire.



[(5+5)+8+8+(6+2)+6]=40

6. (a) A gas obeys the equation of state $P(v - b) = RT$, where b is a constant. Show that for an adiabatic expansion $P(v - b)^{\gamma}$ = constant, where γ is the ratio of the heat capacities and $C_p - C_v = R$.

(b) Write down Maxwell's relations and use the required relations to show that the internal energy U is a function of T only by finding $\left(\frac{\partial U}{\partial T}\right)_V$, $\left(\frac{\partial U}{\partial V}\right)_T$ and hence $\left(\frac{\partial U}{\partial p}\right)_T$.

(c) 10 g of steam at 100°C are blown on the surface of 90g of water at 0°C, contained in a calorimeter of water equivalent 10 g, all the steam being condensed. Calculate the increase in entropy of the system.

(d) What is Joule-Thomson effect (JT)? Show that for a gas obeying van der Waal's equation of state, the temperature of inversion is approximately $\frac{2a}{bR}$ for the JT effect.

(e) Derive Clausius-Clapeyron equation

$$\frac{dp}{dT} = \frac{L}{T(v_2 - v_1)}$$

from Maxwell's relation. Discuss how the boiling point of a liquid and melting point of a solid are affected by the change of pressure. [8+(4+4)+6+(2+6)+(6+4)]=40

Group-B

Answer *any two* questions.

7. (a) Write down the postulates of special theory of relativity. Using the expression for the relativistic momentum $P = \frac{m_o v}{\sqrt{1-\frac{v^2}{c^2}}}$, prove the energy-momentum relation $E^2 = p^2c^2 + m_o^2c^4$, where the symbols have their usual meanings.

(b) Prove that the circle $x^2 + y^2 = a^2$, in a frame S will be seen as an ellipse from another frame S', which is moving with a velocity v along the X-direction with respect to S. Find also the semi-major and semi-minor axis of the ellipse.

(c) Define phase velocity and group velocity. Show that

$v_g = v_p - \lambda \frac{dv_p}{d\lambda}$,

where v_g is the group velocity, v_p is the phase velocity and λ is the wavelength.

(d) If a vessel has a hole of radius r at its bottom, show that the liquid inside will come out of the vessel if its depth exceeds $h = \frac{2T}{r\rho g}$, where T is the surface tension of the liquid, p its density and g the acceleration due to gravity.

(e) State and prove Bernoulli's theorem for streamline flow of an incompressible non-viscous fluid. [(4+6)+(8+2)+(4+4)+5+7]=40

8. (a) State and explain Fermat's principle. Establish, using the principle, the laws of reflection in a plane surface.

   (b) Derive the following relation

   $\frac{n_2}{v} - \frac{n_1}{u} = \frac{n_2 - n_1}{R}$

   for refraction at a convex spherical surface by the matrix method.

   (c) A soap film of refractive index 1.33 is illuminated with light at an angle 45°. There is complete destructive interference for $\lambda = 5890\text{Å}$. Find the thickness of the film. Derive the necessary formula used in the calculation.

   (d) Find the result of superposition of n number of simple harmonic motions having the same amplitude a and the same angular frequency ω, but equal successive phase advancement δ.

   (e) State and explain perpendicular axis theorem. [(4+6)+8+(4+6)+8+4]=40

9. (a) In a series LR circuit with a DC source, find expressions for instantaneous current $I(t)$ in the circuit and instantaneous voltage drop across the inductor V_L. Draw a plot of $I(t), V_L$ versus time and discuss their variations with time.

   (b) Show that the current through pure inductor lags behind the applied ac voltage by a quarter cycle and that through a pure capacitor leads by a quarter cycle.

   (c) Explain how Maxwell generalised Ampere's circuital law. Hence discuss the concept of displacement current.

   (d) Find the state of polarisation when the x-component and y-component of the electric field are $E_x = E_0 \sin(\omega t + kz)\,; E_y = E_0 \cos(\omega t + kz)$.

   (e) Prove that the area of a half-period zone on a plane wavefront is essentially independent of the order of the zone. [(8+2)+(5+5)+(5+3)+6+6]=40

10. (a) Using Laplace's equation find the capacitance of a parallel plate capacitor.

    (b) What do you mean by magnetic scalar potential? Find an expression for the magnetic scalar potential due to a circular current loop at an axial point. Hence calculate the corresponding magnetic field.

    (c) What do you mean by resonance in a series LCR circuit?

    (d) Explain with neat diagram how can you obtain B.H. curve and hysteresis loop of a specimen.

    (e) State and explain what is meant by Gibb's phase rule. Explain why entropy increases in all natural processes. [8+(2+4+4)+4+8+(5+5)]=40

2021

PHYSIOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any six* questions.

1. (a) Explain briefly Vant-Hoff's Laws of osmotic pressure.
   (b) Distinguish between isotonic and iso-osmotic solutions.
   (c) State the significance of osmotic pressure in the human body. 10+6+4=20

2. (a) What is a buffer? Give example.
   (b) Name the buffers present in blood.
   (c) Explain isoelectric pH with example.
   (d) Explain Handerson-Hasselbach Equation and state its significance. (2+2)+4+4+(4+4)=20

3. (a) What is aldose-ketose isomerism?
   (b) What is racemic mixture?
   (c) "Glucose and galactose are epimers of each other"— explain.
   (d) What are polysaccharides?
   (e) Mention the differences between starch and glycogen. 4+4+4+4+4=20

4. (a) Classify lipoproteins. Explain their biological significance.
   (b) What is the normal range of cholesterol level in adult plasma?
   (c) State the physiological importance of cholesterol in the human body. (6+6)+2+6=20

5. (a) Classify amino acids giving suitable examples.
   (b) Write down the systemic names of glycine and phenylalanine.
   (c) Distinguish between nucleoside and nucleotide.
   (d) What are the differences between DNA and RNA? 10+4+4+2=20

6. (a) What are the key enzymes of glycolysis?
   (b) Discuss with a flow chart the oxidative phase of glycolysis, mentioning the names of the enzymes.
   (c) What is substrate level phosphorylation? Give example. 4+12+(2+2)=20

7. (a) Name the substrates which produce acetyl CoA.
   (b) Which is the substrate level phosphorylation step in TCA-cycle?
   (c) What are the steps in TCA-cycle which release CO_2?
   (d) How many ATPs are generated in one rotation of TCA-cycle? 6+4+8+2=20

8. (a) Explain with a flow chart the β-oxidation of fatty acids.
   (b) What is the product of β-oxidation of odd carbon fatty acid?
   (c) Calculate the numbers of ATP generated from complete oxidation of palmitic acid (16C saturated fatty acid). 12+2+6=20

9. (a) What do you mean by transamination and deamination?
   (b) Name the enzymes involved in transamination.
   (c) What are the physiological significances of transamination? 6+4+10=20

10. (a) Define food groups.
    (b) What are the different food groups according to ICMR classification?
    (c) Define balanced diet. 2+15+3=20

Group-B

Answer *any four* questions.

11. (a) Why blood is called a connective tissue?
    (b) Classify leucocytes with a neat flow chart.
    (c) What are the functions of haemoglobin?
    (d) What is Lansteiner's Law?
    (e) What is 'erythro blastosis foetalis'? 2+4+8+2+4=20

12. (a) Distinguish between innate and acquired (adaptive) immunity.
    (b) Mention two functions of plasma proteins in the human body.
    (c) What is a reticulocyte? Why is it so called?
    (d) What are the advantages of biconcave shape of an erythrocyte? 6+8+4+2=20

13. (a) Why cardiac muscle is never fatigued?
    (b) Define cardiac cycle.
    (c) Discuss about the different phases of ventricular cycle. 4+2+14=20

14. (a) Critically discuss the ionic basis of Pacemaker potential.
    (b) Draw and describe the normal human ECG waves. 10+10=20

15. (a) What is "Dead Space"?
    (b) Write the definition, normal value and significance of
        (i) Tidal Volume
        (ii) Inspiratory Capacity
        (iii) Residual Volume
        (iv) Total Lung Capacity 4+(4×4)=20

16. (a) What is a glomerulus? Name the blood vessels entering and leaving it.
    (b) Write briefly about the juxtaglomerular apparatus.
    (c) Give a brief account of glucose reabsorption process in the renal tubules. (2+2)+6+10=20

2021

POLITICAL SCIENCE

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** or in **Nepali** but all answers must be in one and same language.*

Group-A

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

1. What do you understand by the notion of statecraft? Discuss the theory of statecraft as given by Kautilya. 40

2. Differentiate between freedom and liberty. Discuss Marx's theory of freedom. 30

3. What do you mean by democracy? Differentiate between participatory and deliberative democracy. 30

4. What is law? What are the different schools and sources of law? What do you mean by Rule of Law? 30

Group-B

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

5. What are the Rights within the ambit of Article 21 of the Indian Constitution? 40

6. Identify the tension areas in Union-State relations in India. 30

7. Critically analyse the discretionary powers granted to the Governor by the Indian Constitution. 30

8. 'Religion is still an important factor in Indian Politics'. Examine. 30

2021

PSYCHOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. Why is attention selective in nature? Explain with the help of suitable theoretical perspectives. Also discuss the different determinants of attention with suitable examples. 10+15+15=40

2. How does operant conditioning differ from classical conditioning? Critically discuss—

   (a) Trial and error theory,

   (b) Theory of Insight learning. 20+10+10=40

3. Critically discuss the SOI model of intelligence. How does it differ from Gardner's viewpoint? Mention the applications of the model. 15+15+10=40

4. Define attitude. How does attitude formation take place? Can attitude be changed? If yes, elaborate the process with suitable examples. 5+15+20=40

5. Define sensation. Mention its attributes. How can sensation be measured? 5+20+15=40

6. What is meant by forgetting curve? How does forgetting take place in accordance with different theoretical notions? 15+25=40

7. What is meant by interest? Differentiate it from achievement. How can interest be measured? 10+10+20=40

Group-B

Answer *any two* questions.

8. "Cognitive and moral development run parallel to one another." Justify with the help of suitable theoretical perspectives. 40

9. As a psychologist, mention how can the social taboo of casteism and untouchability be curbed. 40

10. 'Perception of time is ubiquitous.' Justify. 40

2021

SOCIOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions. 40×3=120

1. What is meant by 'Sociology as the study of human relationships'? Examine the nature of human relationships in the light of micro and macro levels of understanding with suitable examples.

2. Examine after Max Weber the concept of Bureaucracy as a form of rational authority. What are its functions and dysfunctions?

3. 'Social Stratification is an universal phenomenon'.– Discuss. Do you think that the caste system is still a basic problem of Indian Society? Justify your answer with examples.

4. What did R.K. Merton mean by 'Conformity' and 'Deviance'? Explain with illustration his five modes of adaptation which people adopt due to social pressure.

5. 'Humans are embedded in social organisation'.– Discuss.

Group-B

Answer *any two* questions. 40×2=80

6. Point out the differences between participant and non-participant observation. Explain the advantages and limitations of observation as a form of data collection.

7. Discuss the social functions of religion. What are the differences between religion and magic?

8. What is meant by Information and Communication Technology (ICT)? Discuss its impact on rural society.

2021

STATISTICS

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any four* questions.

1. (a) Give the classical definition of probability. Write down its limitations, if any.

   (b) Define the following:

   (i) Incompatible events

   (ii) Independent events

   (c) The probability that a person can hit a target is $^3/_5$ and the same probability for another person is $^4/_5$. If they fire together, show that the probability that the target will be hit by both of them is always more than $^2/_5$.

   (d) State and prove Bayes Theorem. 6+6+10+8=30

2. (a) In a certain town, the proportions of males and females are equal. If 20% of males and 5% of females are unemployed, what is the probability that a randomly selected person is unemployed? If an unemployed person is selected at random, what is the probability that the person selected is a male?

   (b) Prove that for any random variable X,

   $$\mathrm{E}\,|X - C| \leq \mathrm{E}\,(X - C)^2$$

   for all scalar C. When does equality hold?

   (c) Suppose a coin is tossed until a head appears. If the coin is unbiased and X denotes the number of tosses required, find the median and mode of X.

   (d) If $X \sim N\,(0, 1)$, compute $\mathrm{E}\,\{\phi(X)\}$, where $\phi(x) = \frac{1}{\sqrt{2\pi}} e^{-\frac{1}{2}x^2}, -\infty < x < \infty$. 7+8+8+7=30

3. (a) If $X \sim$ Uniform (0, 2), find the MGF of X and hence the variance of X.

   (b) Show that for a positive random variable X, $\mathrm{E}\,(\mathrm{X}) \geq e^{\mathrm{E}(\log \mathrm{x})} \geq \left[\mathrm{E}\left(\frac{1}{\mathrm{X}}\right)\right]^{-1}$.

   (c) State and prove Markov inequality. 9+15+6=30

4. (a) If $f(x,y)$ is a joint PDF, given by

$$f(x,y) = Ke^{-xy}y^2, x > 0, 0 < y < 3$$
$$= 0 \text{ ow.}$$

(i) Find K.

(ii) Find the conditional PDF of X given $Y = y$.

(iii) Compute $\mathrm{E}(e^X|Y = y)$.

(b) If $f(x,y) = \frac{1}{2}g(x,y,\rho) + \frac{1}{2}g(x,y,-\rho), -\infty < x < \infty, -\infty < y < \infty$ is a joint PDF, where $g(x,y,\rho)$ is the PDF of a $N_2(0,0,1,1,\rho)$ distribution, compute $\mathrm{E}(X)$ and $\mathrm{E}(XY)$. 5+6+8+11=30

5. (a) Suppose X_i are iid with CDF, $F(x) = \frac{x}{x+1}, 0 \le x < \infty$. If M_n is the maximum of $X_1, X_2, \ldots, X_n$, show that $\frac{M_n}{n} \xrightarrow{D} \frac{1}{Y}$, where $Y \sim \mathrm{Exp}(1)$.

(b) Suppose $Y_1, \ldots, Y_n$ are iid uniform $(\theta, \theta + 1)$,

(i) show that

(a) $\bar{Y}$ is biased for θ,

(b) $MSE(\bar{Y}) \to \frac{1}{4}$ as $n \to \infty$.

(ii) Find a sufficient statistic for θ.

(c) Describe p value in the context of hypothesis testing. 12+12+6=30

6. (a) Suppose X_i are iid uniform $(0, \theta)$, $i = 1, \ldots, n$ and $Y_n = \max\{X_1, \ldots, X_n\}$.

(i) Compute the confidence coefficient for the set $[Y_n, \infty]$.

(ii) Find a pivotal quantity for θ in terms of Y_n.

(iii) If n is such that $b^n - a^n = 0{\cdot}96$, find the confidence coefficient of the confidence interval $\left[\frac{Y_n}{b}, \frac{Y_n}{a}\right]$.

(b) Suppose $X_i, i = 1,2,3,4$ are iid $\mathrm{Exp}\left(\text{mean} = \frac{1}{\lambda}\right)$. Corresponding to the data (2,3,3,4), find the maximum likelihood estimate of λ when it is known that λ is either $\frac{1}{4}$ or $\frac{1}{3}$. (4+8+10)+8=30

Group-B

Answer *any two* questions.

7. (a) Consider a CRD with t treatments and replication number r_j, for the jth treatment, $j = 1, \ldots t$ with $\sum_{j=1}^{t} r_j = n$ (fixed). Show that the average variance of all estimated elementary treatment contrasts is minimised when $r_j = \frac{n}{t}$ for all $j = 1, \ldots t$.

(b) Consider a one-way ANOVA fixed effects model with K factor levels and n_K observations for the Kth factor level. If x_{ij} is the jth observation corresponding to the ith level, $j = 1, \ldots, n_i; i = 1,2, \ldots, K$, write down the expression of the F statistic F_1. If we define a new set of observations as $y_{ij} = Ax_{ij} + B$ and compute the F statistic F_2, establish a relation between F_1 and F_2. What is the implication of your finding?

(c) Describe the basic principles of design of experiments. 15+10+15=40

8. (a) Distinguish between sampling and non-sampling errors.

   (b) From a population of N units, n units are drawn by SRSWR, of which only n_1, responded. Out of the remaining $n_2 = n - n_1$ non-responding units, information was later collected on u units, chosen using SRSWR. Show that $\hat{\mu} = \frac{n_1\bar{y}_{n_1} + n_2\bar{y}_u}{n}$ is an unbiased estimator of the population mean, where $\bar{y}_{n_1}(\bar{y}_u)$ is the sample mean based on responding initially (later) units. Also derive Var($\hat{\mu}$).

   (c) Define a ratio estimator. Obtain its exact bias and approximate MSE. Also derive those for estimating the population mean. Define the regression estimator of population mean and compare it with that obtained for ratio method in terms of precision. 10+15+15=40

9. (a) In the context of 2^4 factorial experiment, describe Yate's procedure of forming treatment contrasts.

   (b) Construct a non-randomized layout of $(2^5, 2^2)$ experiment, confounding ACD and BD, where A, B, C, D, E are the factors.

   (c) Consider a $(2^4, 2^2)$ experiment with 4 factors A, B, C, D. One of the blocks is given by

a	b	cd	$abcd$

   (i) Construct the other blocks.

   (ii) Identify the confounded effects. 10+15+15=40

2021

ZOOLOGY

PAPER-I

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be given either in **English** *or in* **Bengali** *but all answer must be in one and same language.*

Group-A

1. Attempt *any ten* questions. 4×10=40

   (a) Discuss salient features and affinities to justify hemichordates as a phylum.

   (b) State the structure and function of septal nephridium in Annelids.

   (c) Compare the aortic arches between urodeles and mammals.

   (d) 'Axolotl' is a neotenic larva—Justify.

   (e) Evaluate termites are eusocial insects.

   (f) Define conjugation. State its significance in Ciliate.

   (g) Discuss the role of air-sacs in avian respiration.

   (h) Distinguish between ecological efficiency and ecological equivalent.

   (i) What is Ozone Problem? State its effects.

   (j) Distinguish between primary and secondary pollutants.

   (k) Characterize the biodiversity hot-spots in India.

   (l) State the principle of aerodynamics in avian flight.

   (m) Elaborate the concept of 'Goodness of fit'.

Group-B

Attempt *any four* questions. 20×4=80

2. Distinguish between: 5×4

   (a) Horns and Antlers

   (b) Barrier reef and Fringing reef

   (c) Progressive and Retrogressive metamorphosis

   (d) Polypoid and Medusoid Zooids.

3. Write notes on the followings: 4×5
   (a) Polymorphism in siphonophore and its significance
   (b) Pseudopodial movement in Protozoa
   (c) Feeding and digestion in Branchiostoma
   (d) Poison apparatus in snake
   (e) Castes mechanism in a bee-colony and its significance

4. (a) Classify Amphibia upto living orders with salient features and examples. 10
   (b) State anatomical peculiarities and affinities of *Limulus* to comment on its systematic position. 10

5. (a) Describe the structure and function of hair in mammals. 8
   (b) Briefly discuss the mechanism of formation of Coral-reef. Add a note on its conservation strategies. 8+4

6. (a) Describe retrogressive metamorphosis in *Ascidia*. State its evolutionary significance. 8+4
   (b) Discuss the structure and functions of osphradium in *Pila*. 8

7. (a) Give a comparative account of hearts between an amphibian and a mammal. 8
   (b) Describe structure and function of Malpighian tubules in an insect. 7
   (c) What are pleopods? State its function. 5

Group-C

Attempt *any four* questions. 20×4=80

8. Write notes on: 5×4
   (a) Type concept
   (b) Biosphere reserve
   (c) Age pyramid
   (d) ANOVA

9. Distinguish between: 4×5
   (a) Taxonomy and Systematics
   (b) Mean deviation and Standard deviation
   (c) *Ex situ* and *in situ* conservation strategies
   (d) Point and Non-point sources of pollution
   (e) Autogenic and Allogenic succession

10. (a) Distinguish between Primary and Secondary succession. 4

(b) Give an explanatory note on hydrosere. 8

(c) Discuss density-independent factors involved with population regulation. 8

11. (a) What are Greenhouse gases? State their sources and effects on man and biosphere. 3+7

(b) What do you mean by ICZN? Delineate four major rules of ICZN. 2+8

12. (a) Discuss cooperative behaviour of animals. State its advantages in group living. 8+2

(b) What is 10% rule in ecology? Discuss the universal model of energy-flow in the ecosystem. 3+7

13. (a) State the basic differences between 't' test and chi-square test. 4

(b) What is life-table and how it is constructed? State its significance. 6+2

(c) Discuss modern management strategies in relation to tiger conservation. 8

2021

BENGALI

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

(উত্তর সাধু বা চলিত যেকোনো একটি ভাষারীতিতে হওয়া বাঞ্ছনীয়।)

বিভাগ-ক

(*যেকোনো তিনটি* প্রশ্নের উত্তর লিখুন।) ৪০×৩=১২০

১। 'অভিসার' বলতে কী বোঝায়? বৈষ্ণব পদাবলীতে 'অভিসার' পর্যায়ের গুরুত্ব কতখানি? এই পর্যায়ের শ্রেষ্ঠ পদকর্তা কে? এই পর্যায়ের আরও দুজন বিশিষ্ট পদকর্তার পদরচনার সঙ্গে তাঁর পদের তুলনামূলক আলোচনা করে এই শ্রেষ্ঠত্বের কারণ নির্ণয় করুন।

২। চণ্ডীমঙ্গল কাব্য অবলম্বনে কবিকঙ্কণ মুকুন্দরাম চক্রবর্তীর সমাজচেতনা ও কৌতুকরস সৃষ্টির নৈপুণ্য বিচার করুন।

৩। 'মেঘনাদবধ কাব্যে'র সূচনায় মধুসূদন লিখেছিলেন—"গাইব, মা বীররসে ভাসি মহাগীত।"—এই প্রতিশ্রুতি কি মধুসূদন শেষপর্যন্ত রক্ষা করতে পেরেছিলেন? বিভিন্ন সর্গের রসসৃষ্টির বিবেচনা করে আপনার মতামত দিন।

৪। 'কপালকুণ্ডলা' উপন্যাসের আখ্যান নির্মাণে নিয়তির ভূমিকা কতটা গুরুত্বপূর্ণ—যুক্তিসহ বিশ্লেষণ করুন।

৫। রবীন্দ্রকাব্যধারার বাঁকবদল ঘটেছে বারংবার। 'পুনশ্চ' সেই বাঁকবদলের চিহ্নগুলি ধারণ করে আছে। 'পুনশ্চ'-র কবিতা অবলম্বনে রবীন্দ্রকাব্যধারার বাঁকবদল বা পর্বান্তরকে চিহ্নিত করুন।

বিভাগ-খ

(*যেকোনো দুটি* প্রশ্নের উত্তর দিন।) ৪০×২=৮০

৬। সুরেশ না মহিম—গুরুত্বের বিচারে কাকে আপনি 'গৃহদাহ' উপন্যাসের প্রকৃত নায়ক মনে করেন? কারও প্রতি ঔপন্যাসিকের বিশেষ কোনও পক্ষপাত কি আপনি দেখতে পেয়েছেন?—যুক্তিসহ আপনার মতামত দিন।

৭। তাঁর দিনলিপির পাতায় বিভূতিভূষণ লিখেছিলেন—"আমি জন্মান্তরের পথিক-আত্মা।" কিংবা "আমি পথে নেমেছি।..... জগতের এই অপূর্ব গতির রূপ আমার চোখে পড়েছে।"—'পথের পাঁচালী' উপন্যাস জুড়ে আছে এই 'পথ', 'পথিক' ও 'পথচলার' দর্শন।—যুক্তিসহ মন্তব্যটি বিশ্লেষণ করুন।

৮। 'পয়োমুখম্' নামটি বাস্তবিকই ব্যঞ্জনাধর্মী। এই নামকরণের মধ্য দিয়ে জগদীশ গুপ্ত প্রবৃত্তির নাগপাশে বন্দি মানুষের স্বরূপ যেমন উন্মোচিত করতে চান, তেমনি খুলে দিতে চান কৃষ্ণকান্তের মুখোশ। গল্প অবলম্বনে লেখকের কৃতিত্বের পরিচয় দিন।

৯। 'অ্যাবসার্ড নাটক' বলতে কী বোঝায়? 'এবং ইন্দ্রজিৎ' নাটকটিকে কি অ্যাবসার্ড নাটক বলা যাবে? যুক্তিসহ আপনার মতামত দিন।

2021

HINDI

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

The figures in the margin indicate marks for each question.

Group-A

निम्नलिखित में से किन्हीं *तीन* प्रश्नों के उत्तर लिखिए। 40×3=120

1. ''कबीर का काव्य प्रचलित धारणाओं और रूढ़ियों के खिलाफ साहस के साथ खड़ा है।'' – कथन की समीक्षा कीजिए।
2. ''भ्रमरगीत के बहाने निर्गुणोपासना की धज्जियाँ उड़ाने में सूर ने कोई कसर नहीं उठा रखी है।''– इस कथन की तर्कपूर्ण आलोचना कीजिए।
3. ''बिहारी एक सफल मुक्तककार कवि हैं।'' – इस कथन को सोदाहरण स्पष्ट कीजिए।
4. अज्ञेय की पठित कविताओं के आधार पर उनके काव्य-शिल्प पर प्रकाश डालिए।
5. नागार्जुन की कविताओं में व्यक्त राजनीतिक चेतना का विश्लेषण कीजिए।
6. ''धूमिल की कविताओं के बिम्ब हालात के संदर्भ में उपजी उसकी गहरी पीड़ा को संश्लिष्ट रूप से उजागर करते हैं।'' पठित कविताओं के आधार पर इस कथन की समीक्षा कीजिए।

Group-B

निम्नलिखित में से किन्हीं *दो* प्रश्नों के उत्तर लिखिए। 40×2=80

7. ''मोहन राकेश ने 'आषाढ़ का एक दिन' नाटक के माध्यम से कलाकार के आत्मसंघर्ष का अंकन किया है।'' – इस कथन की समीक्षा कीजिए।
8. ''प्रेमचंद का 'गोदान' कृषक वर्ग की आत्मकथा है।''– इस कथन की आलोचनात्मक विवेचना कीजिए।
9. 'महाभोज' में प्रयुक्त शिल्पविधि की विशेषताओं का उद्‌घाटन कीजिए।
10. ''हरिशंकर परसाई के निबंधों में व्यक्त व्यंग्य धारदार और मार्मिक होते हैं''– इस कथन की आलोचना कीजिए।

2021

ENGLISH

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

1. Attempt a critical appreciation of the following poem: 50

Milton! thou shouldst be living at this hour:
England hath need of thee: she is a fen
Of stagnant waters: altar, sword, and pen,
Fireside, the heroic wealth of hall and bower,
Have forfeited their ancient English dower
Of inward happiness. We are selfish men;
Oh! raise us up, return to us again;
And give us manners, virtue, freedom, power.
Thy soul was like a Star, and dwelt apart:
Thou hadst a voice whose sound was like the sea:
Pure as the naked heavens, majestic, free,
So didst thou travel on life's common way,
In cheerful godliness; and yet thy heart
The lowliest duties on herself did lay.

2. Answer *any one* question from the following: 50

(a) Would you consider W. B. Yeats's 'Leda and the Swan' to be a disguised narrative for the progress of Western Civilization? Critically analyze the poem to justify your stand.

(b) Compare and contrast the poems 'Journey of the Magi' and 'Burnt Norton' by T. S. Eliot as mediations on time and religious devotion.

(c) Discuss the literary elements used by Sylvia Plath in the poem 'Mirror'.

(d) In the poem 'Introduction' Kamala Das is able to "successfully marshal diverse and tangential themes in one controlled poem" (Daruwalla). Comment with close textual references.

3. Answer *any one* question from the following: 50

   (a) "The impact Osborne had on British theatre is incalculable. With *Look Back in Anger* he brought class as an issue before British audiences." Critically examine this view with close reference to the play.

   (b) Would you agree with the view that Beckett's *Waiting for Godot* is primarily about hope? Argue with close textual references.

   (c) According to Joyce's celebrated biographer, Richard Ellman, Joyce hoped that his *A Portrait of the Artist as a Young man* would be an autobiographical novel, "turning his life into fiction." Discuss the statement with textual references.

   (d) Comment on how Virginia Woolf's '*A Room of One's Own*' illustrates the history of women's literary writing in patriarchal society.

4. Answer *any one* question from the following: 50

   (a) Bring out the complexity of Ghosh's narrative technique in his novel *The Shadow Lines*.

   (b) Do you consider Okonkwo as the tragic protagonist of Achebe's novel *Things Fall Apart*? Discuss with suitable examples from the text.

   (c) How did Tagore conceptualize 'civilization' in his speech '*Crisis in Civilization*'? Substantiate, following the writer's argument, why human civilization was deeply threatened.

   (d) Can Raja Rao's *Kanthapura* be regarded as a postcolonial novel? Justify your argument with reference to the novel.

2021

SANSKRIT

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be written either in **English** *or in* **Bengali** *or in* **Sanskrit** *but all answers must be in one and the same language.*

Answer question nos. 1 *&* 2 *and* any three *of the rest.*

1. What is meant by the term 'Dialogue Hymns'? Are they written only in prose or in poetry? Give an account of such hymns. 6+2+32=40

Or,

What is meant by the term Vedāṅga? What is the total number of Vedāṅgas? Give a brief account of the Vedāṅgas. 6+2+32=40

2. How many sources of knowledge are accepted by Nyāya? Explain the nature of any two of them. 5+35=40

Or,

Explain the arguments for and against the doctrine of self validity of knowledge. 20+20=40

3. Write a comprehensive note on the influence of the *Mahābhārata* upon later Sanskrit literature. 40

4. Give the names of the major works of Aśvaghoṣa and make a critical estimate of them. 40

5. Critically examine the contribution of Māgha in classical Sanskrit poetry. 40

6. Estimate the value of Daṇḍin's *Daśakumāracarita* as a prose romance. 40

7. Show with reference to texts that the study of medicine was quite developed in ancient India. 40

8. Critically comment on Kālidāsa's treatment of nature with reference to the *Abhijñānaśakuntalam*. 40

2021
URDU
PAPER-II

Time Allowed : 3 Hours *Full Marks: 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to prescribed number shall be valued and the remaining ones ignored.

Answer should be written in ***Urdu.***

Group: A

.1 درج ذیل سوالات میں سے کسی چار کے جواب تحریر کیجئے۔ 30×4=120

(i) گنج ہائے گرانمایہ کی روشنی میں رشید احمد صدیقی کی خاکہ نگاری کا جائزہ لیجئے۔

(ii) غالب کی مکتوب نگاری کا تنقیدی جائزہ لیجئے۔

(iii) میر امن دہلوی کی نثری خدمات کو احاطہ تحریر میں لائیے۔

(iv) ''ٹوبہ ٹیک سنگھ'' کی روشنی میں منٹو کی افسانہ نگاری کا جائزہ لیجئے۔

(v) مولانا محمد علی جوہر کا خاکہ اپنی زبان میں تحریر کیجئے۔

(vi) اردو ڈراما کے اجزائے ترکیبی سے اپنی واقفیت کا اظہار کیجئے۔

(vii) ناول گئودان کی روشنی میں پریم چند کو بحیثیت ناول نگار پیش کیجئے۔

Group: B

2. درج ذیل سوالات میں سے کسی دو کے جواب تحریر کیجئے: 20×2=40

(i) احتشام حسین کو بحیثیت تنقید نگار پیش کیجئے۔

(ii) مارکسی تنقید سے اپنی واقفیت کا اظہار کیجئے۔

(iii) ''کلیم الدین احمد کی تنقید انتہا پسندی کی کوکھ سے جنم لیتی ہے''۔ مذکورہ خیال کی وضاحت مع دلائل کیجئے۔

(iv) جمالیاتی تنقید کسے کہتے ہیں۔ بحث کیجئے۔

Group: C

3. درج ذیل عنوانات میں سے کسی ایک پر مضمون لکھئے: 40

(i) اردو صحافت کے دو سو سال

(ii) آن لائن کلاسیس — سودمند یا غیر سودمند

(iii) مولانا ابوالکلام آزاد بحیثیت صحافی

(iv) مغربی بنگال میں اردو افسانہ آزادی کے بعد

2021

PALI

PAPER–II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Candidates may use ***Devnagari*** *or* ***Roman*** or ***Bengali*** Script in their answers.
Quotations or expressions in Pali.

Group-A

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

1. Give a brief account of the various texts constituting the Abhidhamma Pitaka. 30

2. Where and under what circumstances was the First Buddhist Council held? Give an account of the council, pointing out its effect on the Buddhist Samgha. 30

3. Write an informative essay on the Milindapañha. 30

4. Write a critical note on the causes of the decline of Buddhism in India. 30

5. Write short notes on *any four* of the following: 10×4=40
   (a) Theragāthā
   (b) Buddhavaṁsa
   (c) Aśoka the Great
   (d) Dhammapada
   (e) Rājagaha
   (f) Sabbatthivāda

Group-B

Attempt *all* questions.

Answers in this group should be given in ***Pali***.

6. (a) Summarise the contents of *either* the Khaggavisāna-sutta *or* Karaṇīyametta-sutta of the Suttanipāta. 30

or

Summarise the contents of the Appamādavagga *or* the Ambapālī Theri.

(b) Discuss the importance of the Dhammacakkapavattana-Sutta in the history of Buddhism. 30

or

Attempt a critical estimate of the contents of the Dasaratha-Jātaka.

7. (a) Write what do you know about the Vuttodaya *or* the Subodhālaṅkāra? 20

(b) Explain with appropriate examples *any two* of the following: 10×2=20

(i) Tanumajjhā

(ii) Mālinī

(iii) Vasantatilaka

(iv) Dhammopamā

2021

SANTALI

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given in Santali language and 'olchiki' Script.

SECTION-A

1. ᱞᱟᱛᱟᱨ ᱨᱮ ᱮᱢ ᱟᱠᱟᱱ ᱠᱩᱠᱞᱤ ᱠᱚ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱮᱢᱢᱮ (Answer all the questions): 10×5=50

(ᱚ) ᱥᱟᱶᱛᱟ ᱨᱮᱭᱟᱜ ᱚᱠᱟ ᱞᱮᱠᱟᱱ ᱦᱟᱞᱚᱛ ᱨᱮ ᱥᱟᱹᱫᱷᱩ ᱨᱟᱢᱪᱟᱸᱫ ᱢᱩᱨᱢᱩ ᱫᱚ 'ᱫᱮᱵᱚᱱ ᱛᱤᱸᱜᱩᱱ ᱟᱹᱫᱤᱵᱟᱹᱥᱤ ᱵᱤᱨ' ᱥᱮᱨᱮᱧᱮ ᱚᱞ ᱞᱮᱫᱟ ? ᱥᱮᱨᱮᱧ ᱨᱮᱭᱟᱜ ᱥᱟᱛᱟᱢ ᱛᱚᱰᱵᱤᱡᱭ ᱛᱩᱞᱩᱡ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ।

(ᱛ) ᱦᱟᱺᱫᱤ ᱯᱟᱹᱨᱥᱟᱹ. ᱨᱮᱭᱟᱜ ᱟᱹ.ᱛᱷᱟᱹ.ᱨᱦᱤ ᱡᱮᱲᱦᱟᱨ ᱜᱮ ᱥᱟᱱᱛᱟᱲ ᱥᱟᱶᱛᱟ ᱫᱷᱟᱥᱟᱶᱚᱜ ᱨᱮᱭᱟᱜ ᱨᱮᱦᱮᱫ ᱫᱚ ᱠᱟᱱᱟ— ᱡᱷᱚᱨᱚᱢ ᱱᱟᱥᱟᱦᱚᱢ ᱚᱱᱚᱲᱦᱮᱸ ᱨᱮᱭᱟᱜ ᱛᱮᱛᱮᱫ ᱥᱚᱜ ᱥᱮᱷᱮᱡ ᱛᱩᱞᱩᱡ ᱚᱞ ᱵᱩᱡᱷᱟᱹᱣ ᱢᱮ ।

(ᱜ) '... ᱞᱩᱢᱟᱹᱜ ᱞᱮᱠᱟ ᱜᱮᱞᱮ ᱟᱹᱛᱤᱧ ᱦᱮᱡ ᱟᱠᱟᱱᱟ, ᱢᱮᱱᱟᱜ ᱞᱮᱜᱮᱭᱟ । ᱟᱨ ᱢᱤᱫ ᱫᱤᱱ ᱚᱠᱟᱛᱮ ᱡᱚᱜ ᱟᱨᱦᱚᱞᱮ ᱡᱟᱞᱟᱜ-ᱟ' — ᱦᱚᱧ ᱠᱚᱨᱮᱱ ᱢᱟᱨᱮ ᱦᱟᱵᱟᱧᱢ ᱠᱚ ᱨᱮᱭᱟᱜ ᱠᱟᱛᱷᱟ ᱵᱩᱛᱷᱤ ᱨᱮ ᱠᱚᱞᱮᱭᱟᱱ ᱦᱟᱧᱟᱢᱮ ᱞᱟᱹᱭ ᱟᱠᱟᱫ ᱠᱟᱛᱷᱟ ᱨᱮᱭᱟᱜ ᱡᱷᱮᱫᱭ ᱡᱷᱟᱹᱜᱟᱣ ᱢᱮ ।

(ᱝ) ᱥᱟᱱᱛᱟᱲᱤ ᱜᱟᱭᱟᱱ ᱥᱟᱶᱦᱮᱫ ᱨᱮ ᱯᱚᱱᱰᱤᱛ ᱨᱚᱜᱷᱩᱱᱟᱛᱷ ᱢᱩᱨᱢᱩ ᱟᱜ ᱮᱱᱮᱢ ᱚᱞᱢᱮ ।

(ᱞ) ᱥᱚᱜᱥᱟᱨ ᱯᱟᱥᱮᱸᱫᱭ ᱜᱟᱭᱟᱱ ᱨᱮ ᱢᱮᱱᱟᱜ ᱠᱤᱥᱠᱩ ᱨᱟᱯᱟᱡᱭ ᱟᱜ ᱡᱚᱨᱤᱛ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ।

2. ᱡᱟᱦᱟᱸ (᱒) ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱠᱷᱚᱡᱚᱜ ᱞᱮᱠᱟᱛᱮ ᱚᱞᱢᱮ : 25×2=50

(ᱚ) ᱡᱟᱹᱛᱤ ᱢᱤᱞᱚᱱ ᱚᱱᱚᱲᱦᱮᱸ ᱨᱮᱭᱟᱜ ᱛᱮᱛᱮᱫ ᱠᱟᱛᱷᱟ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ।

(ᱛ) ᱥᱟᱱᱛᱟᱲᱟᱜ ᱡᱤᱭᱚᱱ ᱥᱟᱹᱨᱟᱹᱲ ᱨᱮᱭᱟᱜ ᱠᱟᱛᱷᱟ ᱠᱟᱹᱨᱢᱩ ᱟᱨ ᱫᱷᱟᱹᱨᱢᱩ ᱟᱜ ᱠᱟᱹᱦᱱᱤ ᱠᱟᱛᱷᱟ ᱛᱮ ᱚᱠᱟ ᱞᱮᱠᱟ ᱥᱟᱡ ᱨᱟᱠᱟᱡ ᱟᱠᱟᱱᱟ ? ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ।

ᱡᱟᱦᱟᱸᱠᱷᱟᱱ/OR

(ᱜ) ᱡᱚᱢᱥᱤᱢ ᱵᱤᱱᱛᱤ ᱞᱮᱠᱟᱛᱮ ᱥᱟᱱᱛᱟᱲᱟᱜ ᱫᱷᱚᱨᱚᱢ ᱟᱨ ᱥᱮᱨᱮᱧ ᱨᱮᱭᱟᱜ ᱠᱟᱛᱷᱟ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ।

(ᱝ) ᱥᱟᱱᱛᱟᱲᱤ ᱥᱟᱶᱦᱮᱫ ᱨᱮ ᱥᱟᱹᱫᱷᱩ ᱨᱟᱢᱪᱟᱸᱫ ᱢᱩᱨᱢᱩ ᱟᱜ ᱮᱱᱮᱢ ᱚᱞᱢᱮ ।

SECTION-B

3. ᱡᱚᱛᱚ ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱚᱞᱢᱮ (Answer all the questions): 10×5=50

(ᱚ) ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱟᱨ ᱥᱟᱶᱦᱮᱫ ᱩᱛᱱᱟᱹᱣ ᱨᱮ ᱚᱞᱪᱤᱠᱤ ᱨᱮᱭᱟᱜ ᱞᱟᱹᱠᱛᱤ ᱵᱟᱵᱚᱛ ᱟᱢᱟᱜ ᱢᱚᱱᱚᱛ ᱚᱞᱢᱮ ᱾

(ᱛ) ‘ᱥᱟᱱᱛᱟᱲᱤ ᱯᱟᱹᱨᱥᱤ ᱟᱨ ᱥᱟᱶᱦᱮᱫ’ ᱚᱱᱚᱞ ᱨᱮ ᱥᱟᱨᱚᱫᱟ ᱯᱨᱚᱥᱟᱫᱽ ᱠᱤᱥᱠᱩ ᱟᱜ ᱩᱭᱦᱟᱹᱨ ᱵᱷᱟᱵᱽᱱᱟ ᱚᱠᱟ ᱞᱮᱠᱟ ᱥᱚᱫᱚᱨ ᱟᱠᱟᱱᱟ ? ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ᱾

(ᱜ) ᱥᱟᱱᱛᱟᱲᱤ ᱦᱚᱲ ᱠᱟᱹᱦᱱᱤ ᱥᱟᱶᱦᱮᱫ ᱨᱮ ᱥᱤᱠᱷᱱᱟᱹᱛ ᱨᱮᱭᱟᱜ ᱟᱦᱞᱟ ᱚᱠᱟ ᱞᱮᱠᱟ ᱢᱮᱱᱟᱜ ᱟᱠᱟᱫᱟ ? ᱚᱞᱢᱮ ᱾

(ᱝ) ‘ᱵᱷᱟᱨᱚᱛ ᱯᱷᱩᱨᱜᱟᱹᱞ ᱨᱮᱭᱟᱜ ᱯᱚᱭᱞᱳ ᱞᱟᱲᱟᱭᱮᱱᱟ ᱫᱚ ᱛᱟᱦᱮᱸᱠᱟᱱᱟ ᱥᱟᱱᱛᱟᱲ ᱦᱩᱞ’ — ᱱᱚᱣᱟ ᱵᱟᱵᱚᱛ ᱟᱢᱟᱜ ᱵᱤᱪᱟᱹᱨ ᱡᱩᱠᱛᱤ ᱥᱟᱞᱟᱜ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ᱾

(ᱞ) ᱴᱷᱟᱹᱠᱩᱨ ᱯᱨᱚᱥᱟᱫᱽ ᱢᱩᱨᱢᱩ ᱟᱜ ‘ᱥᱮᱛᱟᱜ ᱰᱮᱱᱮᱞ’ ᱚᱱᱚᱲᱦᱮᱸ ᱨᱮ ᱚᱠᱟ ᱞᱮᱠᱟᱱ ᱥᱮᱛᱟᱜ ᱨᱮᱭᱟᱜ ᱪᱤᱛᱟᱹᱨ ᱚᱱᱚᱲᱦᱤᱭᱟᱹᱜ ᱜᱟᱵᱟᱱ ᱟᱠᱟᱫᱟ ? ᱚᱞ ᱯᱩᱥᱴᱟᱹᱣ ᱢᱮ ᱾

4. ᱵᱟᱨᱭᱟ (᱒) ᱠᱩᱠᱞᱤ ᱨᱮᱭᱟᱜ ᱛᱮᱞᱟ ᱠᱷᱟᱡᱚᱜ ᱠᱟᱱ ᱞᱮᱠᱟᱛᱮ ᱚᱞᱢᱮ : 25×2=50

(ᱚ) ᱥᱟᱨᱚᱫᱟ ᱯᱨᱚᱥᱟᱫᱽ ᱠᱤᱥᱠᱩ ᱟᱜ ᱠᱟᱹᱦᱱᱤ ᱜᱟᱵᱟᱱ ᱦᱚᱨᱟ ᱵᱟᱵᱚᱛ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ᱾

(ᱛ) ᱛᱩᱞᱟᱹᱡᱚᱠᱷᱟ ᱥᱟᱶᱦᱮᱫ ᱨᱮᱭᱟᱜ ᱞᱟᱹᱠᱛᱤ ᱟᱨ ᱢᱚᱦᱚᱛ ᱵᱟᱵᱚᱛ ᱯᱩᱥᱴᱟᱹᱣ ᱛᱮ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ᱾

ᱵᱟᱝᱠᱷᱟᱱ/OR

(ᱜ) ᱱᱟᱨᱟᱭᱚᱱ ᱥᱚᱨᱮᱱᱟᱜ ᱠᱟᱹᱦᱱᱤ ᱜᱟᱵᱟᱱ ᱦᱚᱨᱟ ᱵᱟᱵᱚᱛ ᱚᱞ ᱥᱚᱫᱚᱨ ᱢᱮ ᱾

(ᱝ) ᱥᱟᱱᱛᱟᱲᱟᱜ ᱟᱭᱳ ᱟᱲᱟᱝ ᱵᱟᱲᱦᱟᱣ ᱯᱟᱥᱱᱟᱣ ᱨᱮ ᱯᱚᱱᱰᱤᱛ ᱨᱚᱜᱷᱩᱱᱟᱛᱷ ᱢᱩᱨᱢᱩ ᱟᱜ ᱮᱱᱮᱢ ᱚᱞᱢᱮ ᱾

2021

AGRICULTURE

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and the same language.*

Group-A

Answer *any three* questions.

1. (a) Write down the role of genetics in crop improvement. 10

   (b) Write in brief cell structures and functions. Illustrate chromosome structure. 20

   (c) Describe the law of heredity and application in crop improvement research. 10

2. (a) Write in brief the history of plant breeding and its contribution in Indian agriculture. 10

   (b) Elaborate on the concept of crop genetics resources and conservation. 20

   (c) Describe different breeding methods. 10

3. (a) What are molecular markers and DNA Finger Print? Elaborate with suitable examples. 10

   (b) What do you mean by GM Crops? Critically examine the role of GM Crops in agricultural development. 10

   (c) What do you mean by Photoperiodism and stress physiology? Explain in brief. 20

4. (a) What is a quality seed and what is seed testing? 10

   (b) Write in brief the different stages of the seed certification process. 10

   (c) What factors should a farmer consider while he is going to produce seeds on his own farm? 20

5. (a) What is Landscaping and what way it is related to Good Agricultural Practices? 20

   (b) Write down the principles and features of Landscaping. 10

   (c) What do you mean by protected cultivation and what are its advantages? 10

Group-B

Answer *any two* questions.

6. Write short notes on *any five*: 8×5=40

   (a) Export of agricultural products

   (b) Post-harvest technology

   (c) Medicinal and aromatic crops

   (d) Heterosis vigour

   (e) Somatic hybridization

   (f) Plantation and spices

   (g) Plant growth substances

7. (a) Elaborate the issues of food and nutrition security in India. 20

   (b) Explain the Selfing and Crossing techniques with examples. 10

   (c) What do you mean by IPM? Elaborate with examples. 10

8. (a) What is an ideal orchard? What are the horticultural crops suitable for orchards with commercial purposes at the farm level? 20

   (b) Describe cultivation practices of any two horticultural crops that are commercially successful and popular amongst farmers. 20

2021

ANIMAL HUSBANDRY AND VETERINARY SCIENCE

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in **English** *or in* **Bengali** *but all answer must be in one and same language.*

Group-A

Answer *Q.1* and *any two* from the rest.

1. Write in brief *any ten* of the following: 10×10=100
   (i) Give the internal morphological features of different chambers of bovine heart with diagram.
   (ii) Flow-diagramatically represent the intrinsic mechanism of blood coagulation.
   (iii) Define bioavailability and discuss the factors affecting bioavailability.
   (iv) Describe different types of anaemia.
   (v) Enlist various micotoxins. Discuss the toxicity and pathogenesis of aflatoxicosis in poultry.
   (vi) What is 'Lumpy Skin Disease'? Give the symptoms, treatment, prevention and control of this disease.
   (vii) Describe the gross anatomical features of compound stomach in cattle mentioning the major differences with stallion.
   (viii) Describe various phases of cardiac cycle. How cardiac output is regulated?
   (ix) What is BSE and what are the symptoms? How you diagnose it? What managemental strategies should adopt to control the disease?
   (x) Give a brief note on symptoms, diagnosis and treatment protocol of canine distemper.
   (xi) What steps should be taken for prevention of Rabies in man and the constrains?
   (xii) What is antibiotic drug resistance? Discuss the steps to be taken to overcome this problem.

2. State the prevalence of Tuberculosis in India. How this disease is transmitted? Mention the symptoms and lesions of this disease. Give the diagnosis, treatment and control of Tuberculosis. 2+2+10+6=20

3. (a) Describe in brief renin-angiotensin system.
   (b) Describe branching, course and distribution pattern of the brachial plexus in cattle. 10+10=20

4. Briefly enumerate the epidemiology, symptoms, diagnosis, prevention and control of FMD. 20

Group-B

Answer *any two* questions.

5. (a) Describe the different parts of oviduct in hen.
   (b) Write down the difference between cell-mediated and humoral immunity.
   (c) Give a note on the thermoregulatory mechanism in animal body during heat stress. 10+10+10=30

6. (a) Discuss the economic loss happens due to important diseases in bovines.
   (b) What is PPR? Write about susceptible host, mode of transmission, symptoms, diagnosis, treatment and control of PPR. 10+20=30

7. Write in brief about: 6×5=30
   (a) Herd Health Management
   (b) Importance of VPH
   (c) Animal Welfare Board
   (d) Conservation of Wildlife
   (e) Trypanosomiasis

2021

ANTHROPOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

(Answer *any three* questions)

1. Give an account of the significance of village studies conducted in India. Write briefly on the Ethnoarchaeology in India with special reference to mortuary practices and megalithic burials. 20+20=40

2. Discuss on the Linguistic elements of Indian population as proposed by S.K. Chatterjee. How are the Linguistic minorities defined? What are their problems? 20+10+10=40

3. Discuss what do you understand by socio-cultural dimension of health. Discuss briefly the scope of Medical Anthropology. Enumerate briefly the concept of Ethnomedicine in Anthropology. How Anthropology can play a significant role in Development? 10+10+10+10=40

4. Define Demography. Compare between Population Study and Demography. Briefly enumerate Malthusian Theory, Theory of Optimal Population and Theory of Demographic Transition. Enumerate briefly the factors influencing fertility. 5+5+20+10=40

5. Write short notes on *any two* of the following: 20×2=40

   (a) T.C. Das

   (b) Narmada Man

   (c) 6th Schedule

   (d) Art and Architecture of Indus Valley Civilization

Group-B

(Answer *any two* questions)

6. Discuss the approach of N.K. Bose in studying Indian Civilization with special reference to Hindu mode of Tribal Absorption. What do you know about Sacred Complex in India? 30+10=40

7. Describe the developmental programmes taken during Five Year Plan Periods since 1950 for the tribals of India. 40

8. What are the major impacts found on tribal societies in India during colonial ruling? Discuss the impact of modern democratic institutions on tribal political system after Independence. 20+20=40

2021

BOTANY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *or in* ***Nepali*** *but all answers must be in one and same language.*

Answer *any five* questions. 40×5=200

1. Answer *any four* from the following:

   (a) Describe in brief:

   (i) Check-points of cell-cycle

   (ii) ATP generation from TCA cycle

   (iii) Active principle and uses of *Adhatoda* 4+3+3=10

   (b) Distinguish between:

   (i) Symbiotic and non-symbiotic nitrogen fixation

   (ii) Mass selection and pure-line selection

   (iii) Complete and incomplete linkage 3+4+3=10

   (c) Answer in brief:

   (i) Explain the concept of RNA world.

   (ii) State the causes of heterosis.

   (iii) Describe the role of phytochrome in flower initiation. 3+4+3=10

   (d) Explain with diagram:

   (i) Z-scheme

   (ii) Allosteric enzyme regulation

   (iii) Transcription in prokaryotes 4+3+3=10

   (e) Justify:

   (i) In a region of high interference, we observe few double crossing-overs.

   (ii) Amino acids can be classified on the basis of their side chains.

   (iii) DNA markers can be used in plant breeding. 3+4+3=10

2. Answer *any four* from the following:

   (a) Write short notes on: 5×2=10

   (i) Multiple alleles

   (ii) Chi-square test

(b) Explain: 5+5=10

(i) Degeneracy of genetic code

(ii) Physiology of senescence and ageing

(c) Compare:

(i) Triploidy and Trisomy

(ii) Zygotic and somatic embryogenesis

(iii) Photosynthetic efficiencies of C_3 and C_4 plants 4+3+3=10

(d) Describe the biochemical reactions involved in β-oxidation of fatty acids. State the significance of the process. 8+2=10

(e) (i) What are epimers? Cite example. State differences between D-glucose and d-glucose? 1+1+3=5

(ii) Discuss origin of amphidiploids and their importance. 3+2=5

3. Answer *any four* from the following:

(a) Describe only with diagram/flow chart:

(i) Organization of chromatin to form a metaphase chromosome based on Nucleosome concept

(ii) EMP pathway 5+5=10

(b) (i) Write the process of biosynthesis of IAA from tryptophan.

(ii) Write a note on secondary structure of proteins. 5+5=10

(c) Compare between:

(i) B-form and Z-form of DNA

(ii) Euploids and aneuploids 5+5=10

(d) Discuss in brief:

(i) Cytoplasmic inheritance in plants

(ii) Ultra structure of mitochondria 5+5=10

(e) Give an illustrated account of the different stages of Prophase I in meiosis. 10

4. Answer *any four* from the following:

(a) Explain briefly: 5×2=10

(i) R-DNA technology

(ii) Theories of heterosis.

(b) Discuss the triplet-binding technique for deciphering genetic code. Explain Wobble hypothesis. 6+4=10

(c) Explain Mendel's laws of inheritance. State the monohybrid and dihybrid test-cross ratios according to Mendel. 8+2=10

(d) Distinguish between: 5×2=10

(i) Transition and transversion

(ii) Competitive and non-competitive enzyme action

(e) (i) Describe the importance of pharmacognosy in modern medicine.

(ii) Explain the laws of probability. 5+5=10

5. Answer *any four* from the following:

(a) Write notes on: 5×2=10

(i) Nuclear pore complex

(ii) Structure of endoplasmic reticulum

(b) Answer the following: 2×5=10

(i) What do you mean by covalent and non-covalent bonds?

(ii) Why pH 7 is considered as neutral pH?

(iii) Name two metalloenzymes.

(iv) What is meant by a reducing sugar? Give an example.

(v) Define free-energy of a chemical reaction.

(c) Explain in brief:

(i) Mechanism of opening and closure of stoma

(ii) Photolysis of water 5+5=10

(d) What are crude drugs? Describe different methods of microscopic and biological evaluation of drugs. 2+8=10

(e) Distinguish between: 5×2=10

(i) Oxygenase and oxidase

(ii) Deletion and duplication of chromosomes

6. Answer *any four* from the following:

(a) What is a cloning vector? State the properties of an ideal cloning vector. Name two restriction endonucleases and their sources. 2+4+4=10

(b) (i) According to height 200 jute plants can be grouped as follows:

Class Value (in cm)	Frequency
60	10
62	30
64	75
66	50
68	30
70	5

Calculate the mean height and standard deviation.

(ii) State the principle and applications of electron microscopy. 5+5=10

(c) What is primary seed dormancy? How does it differ from quiescence? What are the main causes of seed dormancy and bud dormancy? Describe briefly the methods of artificially breaking seed dormancy. 2+2+3+3=10

(d) Distinguish between: 2×5=10

(i) Codon and anticodon

(ii) Euchromatin and heterochromatin

(iii) Nucleotide and nucleoside

(iv) PCR and RT-PCR

(v) Variance and standard deviation

(e) Write notes on:

(i) Northern blotting technique

(ii) Anatomical evidences of organic evolution 5+5=10

7. Answer *any four* from the following:

(a) (i) Draw the structures of purines and pyrimidine bases of nucleic acids.

(ii) Write a note on fine structure of genes. 5+5=10

(b) (i) What are oncogenes?

(ii) What is meant by aminoacylation of t RNA?

(iii) State the steps of *Agrobacterium*-mediated gene transfer. 2+3+5=10

(c) What is phloem loading and unloading? Describe the mechanism of translocation through phloem, with special reference to mass-flow hypothesis. 2+8=10

(d) (i) Give an outline of interrelationship of basic metabolic pathways with secondary metabolite biosynthesis.

(ii) Describe, in brief, the role of ethylene in fruit ripening. 5+5=10

(e) (i) Discuss the aseptic manipulations required in tissue culture laboratory.

(ii) In a population of 100 persons tested for their MN blood types, the genotypic data found were MM = 66, MN = 20, NN = 14, Prove that the population was in Hardy-Weinberg's equilibrium. 5+5=10

2021

CHEMISTRY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be written either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

Section-I

This Section comprises 15 questions in three Groups. Answer *any ten* questions taking *at least three* questions from each Group.

Group-A

1. Using 18C rule as a guide, find the number(n) of carbonyl (CO) ligands in $[Co(\eta^5 - C_5H_5)(CO)_n]$ and using the same rule establish the possible structure of $Co_4(CO)_{12}$. 2+2=4

2. What happens when $[V(CO)_6]$ and $[Mn_2(CO)_{10}]$ are separately reacted with metallic Na? 2+2=4

3. Cu(II) does not disproportionate whereas Au(II) disproportionates to Au(I) and Au(III). Explain. 4

4. Which organometallic compounds in sea water can methylate Hg(II) ions in sea water? Which natural product transfers its methyl group to Hg(II) in water? 1+3=4

5. Which compounds are called 'inverse spinels'? Cite one example. Why is this naming? 2+1+1=4

Group-B

6. Boiling points of aqueous solutions of 1 molal sucrose and 1 molal NaCl are different— Explain. 4

7. What is the essence of Franck-Condon principle? How is it reflected on the Jablonski diagram? 4

8. For homogeneous catalysis, rate of reaction increases linearly with concentration of the added catalyst. But it does not happen the same way during heterogeneous catalysis— Justify. 4

9. A first order reaction takes 20 minutes for 10% of the reactant to undergo the reaction. Calculate the time needed for 10% of the reactant to remain unreacted. 4

10. Bond length of a diatomic molecule is generally determined from rotational or microwave spectroscopy. However, the essential criterion for a molecule to be active to rotational spectroscopy is that the molecule must have permanent dipole moment. Then how can one determine the bond lengths of molecules like H_2, O_2 or N_2? 4

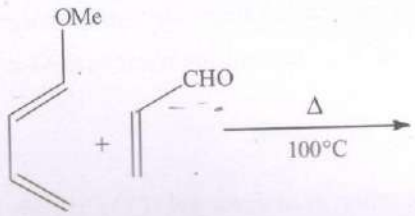
Group-C

11. Draw the conformers of 1-methyl-1-Phenylcyclohexane. Mention the isomeric relationship between them. Predict the most stable conformer. 4

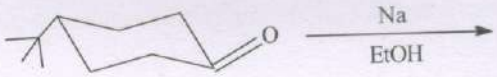
12. Draw the most stable conformetion of D–(+)-glucose. 4

13. Draw the preferred conformer of *cis*-cyclohexane-1, 3-di ol and explain with reason. 4

14. Write the product(s) of the following reaction. Comment on its formation. 4



15. Predict the product(s) of the following reaction with mechanism. 4



Section-II

This Section comprises *six* questions in three Groups. Answer *any four* questions taking *at least one* question from each Group.

Group-A

1. (a) Cite one example of a coordination compound,
   (i) which is thermodynamically stable but its exchange rate with its own ligand is very fast.
   (ii) which is thermodynamically stable but its exchange rate with its own ligand is very slow.
   (iii) Which is thermodynamically stable but its exchange rate with its own ligand is moderate 1+1+1=

   (b) For high spin octahedral Co(II) complexes, the observed magnetic moments are higher tha the spin-only moment. Explain.

(c) Consider the following two reductive transformations:

$SiCl_4 \longrightarrow SiH_4$

$GeCl_4 \longrightarrow GeH_4$

Which transformation needs $LiAlH_4$ and which needs Zn/HCl? Explain. 2+2=4

(d) What is meant by 'Polytopal' isomers or 'Allogons'? Cite one example with only the outline of their conversions. 2+3=5

(e) A metal ion M^{2+} forms complexes of composition $M(en)_3^{2+}$, $M(H_2O)_6^{2+}$ and MBr_6^{4-} which are differently colored like blue, red and green, respectively. Identify which complex is green using CFT(en = ethylenediamine). 3

(f) Although aqueous solution of Fe(II) rapidly undergoes irreversible oxidation in air, the metalloprotein haemoglobin reversibly binds dioxygen (O_2) without being oxidised. Explain this fact. 6

(g) $Na_2[Fe(CO)_4]$ acts as a Grignard like reagent. Justify. What is the coordination geometry around the Fe^{2-} ion? 4+1=5

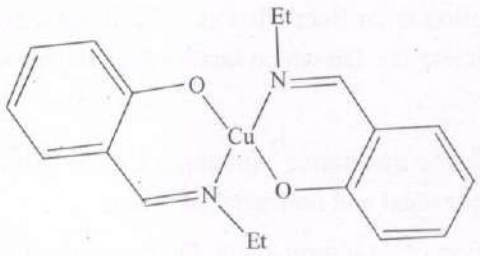
(h) While aqueous Fe(II) reacts with $EDTA^{4-}$ rapidly at normal laboratory temperature, aqueous Cr(III) reacts extremely slowly. Explain. 4

(i) Deoxyhaemoglobin is weaker Bronsted acid than oxyhaemoglobin. Explain this observation. 7

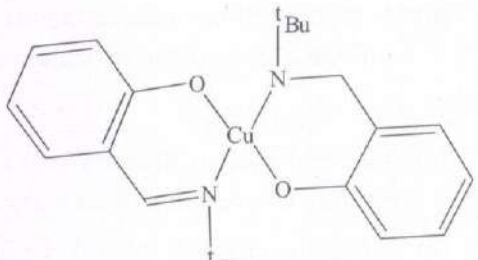
2. (a) Mo(v) is a $4d^1$ system. $(NH_4)_2[MoOCl_5]$ is paramagnetic ($\mu \approx 1{\cdot}73$ BM) whereas [Mo O_2Q Py] is diamagnetic (HQ is quinaldic acid). Mo O_2Q Py has pentavalent Mo. Generalise the magnetic data. 6

(b) Write a short explanatory note on 'Spin State Isomerism' with at least one typical example. 4

(c) Which of the two following Cu(II) complexes can be reduced more easily? 4



(1)



(2)

(d) Consider the lattice energies of the halides CaX_2 to ZnX_2 (X = F, Cl, Br or I). It is expected that a gradual increase in lattice energy should be observed from CaX_2 to ZnX_2 due to size factors of the cations. However, it is experimentally seen that the gradual increase is deviated in the regions of V^{2+} and Ni^{2+}. Explain this observation. 5

4. (a) What are the differences between physisorption and chemisorption? Show that Langmuir adsorption isotherm in certain situation is converted to Freundlich adsorption isotherm. 3+7=10

(b) Use of catalyst can not shift the equilibrium of a chemical reaction. Still costly catalysts are used by the chemical companies. Explain the benefit of using a catalyst. 5

(c) Given the structure of linear CO_2 molecule how can you judge whether a typical mode of vibration will be IR active or inactive? Explain why it is essential to change the potential energy curve (PEC) for a stretching vibration from parabolic pattern to Morse potential energy pattern. On the same qualitative plot present a harmonic and an anharmonic (Morse) PEC. From the drawing how do you get the bond dissociation energy? 3+2+3+2=10

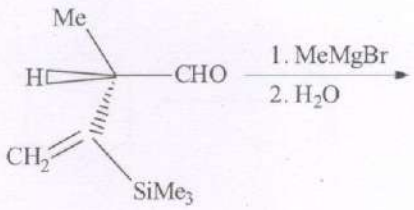
(d) What is an inhibitor? How does it work? 2+5=7

(e) Define fluorescence and phosphorescence. Singlet to Triplet or Triplet to Singlet radiative transition is forbidden. Still we observe phosphorescence— How? 4+4=8

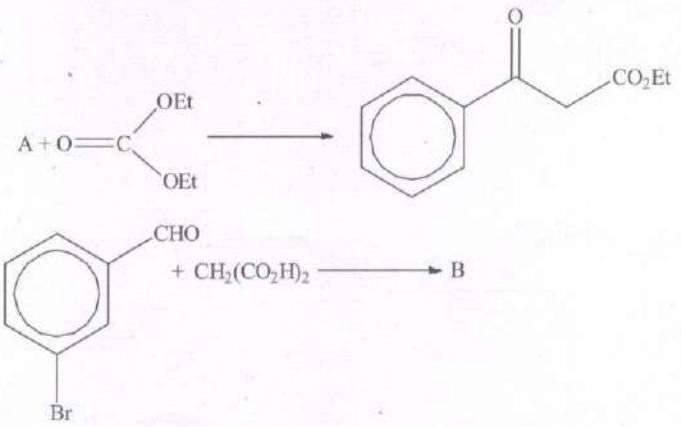
Group-C

5. (a) Predict the possible stereoisomers of PhCH(OH)CH = CHMe. Assign their E/Z and R/S nomenclature. 10

(b) Determine the major and minor product obtained in the following reaction. Assign their stereoisomeric relationship. 10



(c) Identify "A" and "B" in the following reactions. Write the mechanism involved in the reactions. 10



10. Bond length of a diatomic molecule is generally determined from rotational or microwave spectroscopy. However, the essential criterion for a molecule to be active to rotational spectroscopy is that the molecule must have permanent dipole moment. Then how can one determine the bond lengths of molecules like H_2, O_2 or N_2? 4

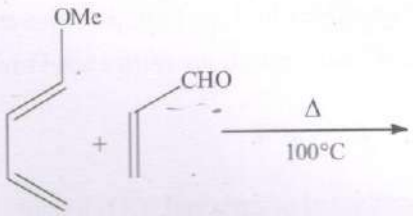
Group-C

11. Draw the conformers of 1-methyl-1-Phenylcyclohexane. Mention the isomeric relationship between them. Predict the most stable conformer. 4

12. Draw the most stable conformetion of D–(+)-glucose. 4

13. Draw the preferred conformer of *cis*-cyclohexane-1, 3-di ol and explain with reason. 4

14. Write the product(s) of the following reaction. Comment on its formation. 4



15. Predict the product(s) of the following reaction with mechanism. 4

Section-II

This Section comprises *six* questions in three Groups. Answer *any four* questions taking *at least one* question from each Group.

Group-A

1. (a) Cite one example of a coordination compound,
   (i) which is thermodynamically stable but its exchange rate with its own ligand is very fast.
   (ii) which is thermodynamically stable but its exchange rate with its own ligand is very slow.
   (iii) Which is thermodynamically stable but its exchange rate with its own ligand is moderate. 1+1+1=3

   (b) For high spin octahedral Co(II) complexes, the observed magnetic moments are higher than the spin-only moment. Explain. 3

(c) Consider the following two reductive transformations:

$SiCl_4 \longrightarrow SiH_4$

$GeCl_4 \longrightarrow GeH_4$

Which transformation needs $LiAlH_4$ and which needs Zn/HCl? Explain. 2+2=4

(d) What is meant by 'Polytopal' isomers or 'Allogons'? Cite one example with only the outline of their conversions. 2+3=5

(e) A metal ion M^{2+} forms complexes of composition $M(en)_3^{2+}$, $M(H_2O)_6^{2+}$ and MBr_6^{4-} which are differently colored like blue, red and green, respectively. Identify which complex is green using CFT(en = ethylenediamine). 3

(f) Although aqueous solution of Fe(II) rapidly undergoes irreversible oxidation in air, the metalloprotein haemoglobin reversibly binds dioxygen (O_2) without being oxidised. Explain this fact. 6

(g) $Na_2[Fe(CO)_4]$ acts as a Grignard like reagent. Justify. What is the coordination geometry around the Fe^{2-} ion? 4+1=5

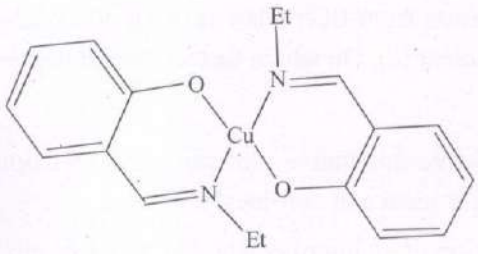
(h) While aqueous Fe(II) reacts with $EDTA^{4-}$ rapidly at normal laboratory temperature, aqueous Cr(III) reacts extremely slowly. Explain. 4

(i) Deoxyhaemoglobin is weaker Bronsted acid than oxyhaemoglobin. Explain this observation. 7

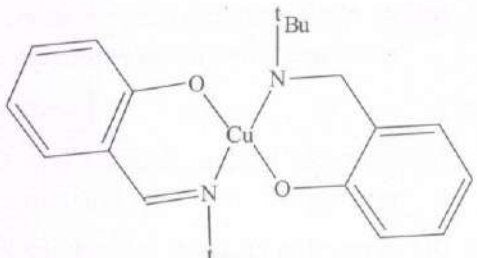
2. (a) Mo(v) is a $4d^1$ system. $(NH_4)_2[MoOCl_5]$ is paramagnetic ($\mu \approx 1{\cdot}73$ BM) whereas [Mo O_2Q Py] is diamagnetic (HQ is quinaldic acid). Mo O_2Q Py has pentavalent Mo. Generalise the magnetic data. 6

(b) Write a short explanatory note on 'Spin State Isomerism' with at least one typical example. 4

(c) Which of the two following Cu(II) complexes can be reduced more easily? 4



(1)



(2)

(d) Consider the lattice energies of the halides CaX_2 to ZnX_2 (X = F, Cl, Br or I). It is expected that a gradual increase in lattice energy should be observed from CaX_2 to ZnX_2 due to size factors of the cations. However, it is experimentally seen that the gradual increase is deviated in the regions of V^{2+} and Ni^{2+}. Explain this observation. 5

(e) Comment on the origin of color and magnetic behaviour of hemerythrin in its oxygen bound state. 2+2=4

(f) Although oxygen is assumed to be a weak field ligand, how oxygen insertion to deoxy-haemoglobin results in the spin state change from high spin to low spin? 6

(g) Consider the three following reactions:

$$M + LL \rightleftharpoons M(LL)\ K_1$$
$$M(LL) + LL \rightleftharpoons M(LL)_2\ K_2$$
$$M(LL)_2 + LL \rightleftharpoons M(LL)_3\ K_3$$

where M is a transition metal ion, LL is bidentate ligand and K_1, K_2, K_3 are the stability constants respectively for the species M(LL), $M(LL)_2$ and $M(LL)_3$. Show that $K_1 : K_2 : K_3$ is $\frac{12}{1} : \frac{5}{2} : \frac{4}{15}$ 7

(h) For a d^3 system, show the possible three electronic transitions in the coordination system. 4

Group-B

3. (a) Knowing the cross sectional area of a single molecule of the adsorbed gas molecule and using the following BET equation how can you get the surface area of a solid catalyst (in powder form) per gram?

$$\frac{p}{v[p_0 - p]} = \frac{c-1}{v_m c}\left(\frac{p}{p_0}\right) + \frac{1}{v_m c}$$

Where v = volume of adsorbed gas

p = equilibrium pressure of adsorbate

p_0 = saturation pressure of adsorbate

c = BET constant

v_m = v corresponding to a monlayer 9

(b) At higher solution concentrations deviation from Beer's law is often observed— justify or criticise. Define molar extinction coefficient (ε). On which factors does it depend? 3+2+4=9

(c) State and explain Raoult's law. On a same qualitative plot show the variation of vapour pressure as a function of mole fraction for ideal and non-ideal solutions. (2+3)+3=8

(d) A reaction proceeds through the formation of an intermediate. On the same qualitative plot show the variation of concentration of the (i) reactant, (ii) intermediate and (iii) product as a function of time. Justify your plot. 3+4=7

(e) What is meant by number average (M_N) and mass average molecular mass (M_W) of a polymer? Name one method each for the determination of the two types of molecular masses. Ideally when can you expect same value of the two molecular masses of a polymer? 3+2+2=7

4. (a) What are the differences between physisorption and chemisorption? Show that Langmuir adsorption isotherm in certain situation is converted to Freundlich adsorption isotherm. 3+7=10

(b) Use of catalyst can not shift the equilibrium of a chemical reaction. Still costly catalysts are used by the chemical companies. Explain the benefit of using a catalyst. 5

(c) Given the structure of linear CO_2 molecule how can you judge whether a typical mode of vibration will be IR active or inactive? Explain why it is essential to change the potential energy curve (PEC) for a stretching vibration from parabolic pattern to Morse potential energy pattern. On the same qualitative plot present a harmonic and an anharmonic (Morse) PEC. From the drawing how do you get the bond dissociation energy? 3+2+3+2=10

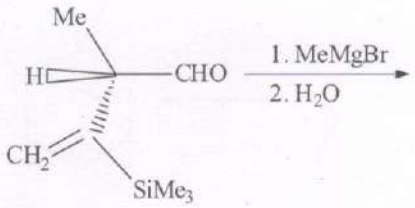
(d) What is an inhibitor? How does it work? 2+5=7

(e) Define fluorescence and phosphorescence. Singlet to Triplet or Triplet to Singlet radiative transition is forbidden. Still we observe phosphorescence— How? 4+4=8

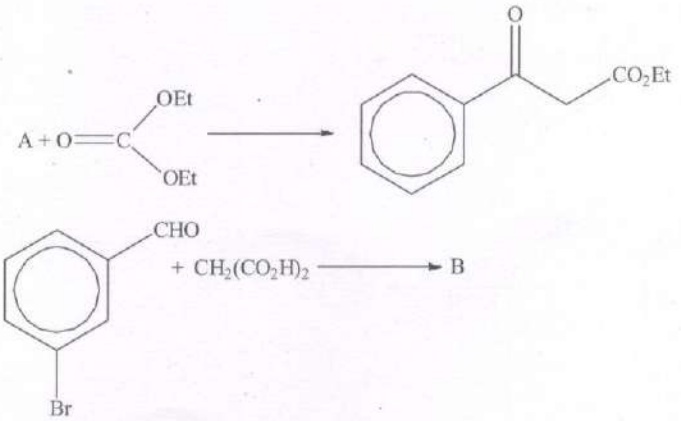
Group-C

5. (a) Predict the possible stereoisomers of PhCH(OH)CH = CHMe. Assign their E/Z and R/S nomenclature. 10

(b) Determine the major and minor product obtained in the following reaction. Assign their stereoisomeric relationship. 10

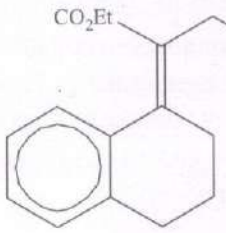


(c) Identify "A" and "B" in the following reactions. Write the mechanism involved in the reactions. 10



(d) Synthesize following compounds as directed.

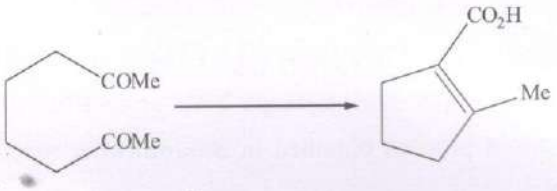
(i) CH_3–CH=CH–CO_2H through Knoevenagel reaction

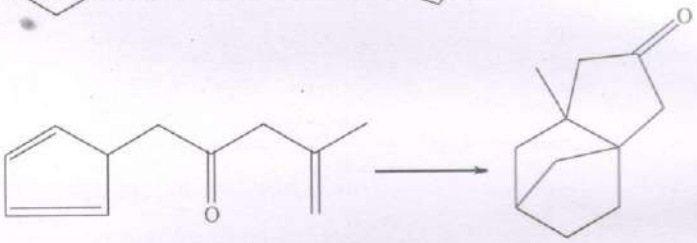
(ii) 

through Stobbe condensation 10

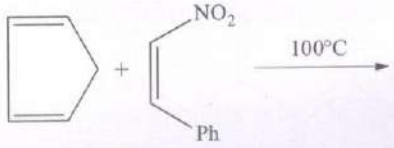
6. (a) Depict all possible stereoisomers of tartaric acid. Assign their stereoisomeric relationship and R/S notation. 10

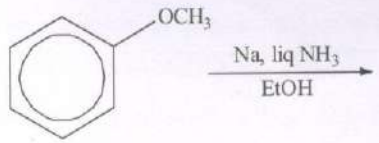
(b) Carry out following synthesis: 5×2=10

(i) 

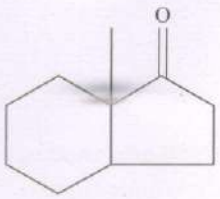
(ii) 

(c) Predict the following product(s) with mechanism: 5×2=10

(i) 

(ii) 

(d) Identify A – J: 1×10=10

(i) 

$$\xrightarrow{PhCHO} A \xrightarrow[AlCl_3]{LAH} B \xrightarrow{O_3} C$$

(ii) $CH_3CO_2Et + (CH_2)_5(MgBr)_2 \xrightarrow{Et_2O} D \xrightarrow{-MgBr(OEt)} E \xrightarrow{H^+} F \xrightarrow[-H_2O]{H^+} G$

(iii) $\begin{matrix} CH_2CO_2H \\ | \\ CH_2 - CO_2H \end{matrix} \xrightarrow{LAH} H \xrightarrow[\substack{ii)\ KCN \\ iii)\ H_3O^+}]{i)\ HBr} I \xrightarrow[ii)\ 300°C]{i)\ \Delta,\ Ac_2O} J$

2021

CIVIL ENGINEERING

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be given either in **English** *or in* **Bengali** *but all answer must be in one and the same language.*

All notations/symbols have their usual meanings, unless otherwise specified.

Group-A

Answer *any four* questions. 32×4=128

1. (a) What are the major advantages of nondestructive method of testing for concrete? Name three(3) main important nondestructive tests on concrete. Describe the properties of concrete that can be estimated from such tests.

   (b) Explain the term 'Activity' in project network analysis for civil engineering projects. What are the reasons for using dummy activity?

   (c) A construction company has an opportunity to submit bid document for construction of a building. From specifications, PERT network along with 3 time estimates (in week) were found out and are shown in Fig. 1 below. Determine the critical path and its standard deviation. (4+3+5)+(2+2)+(12+4)=32

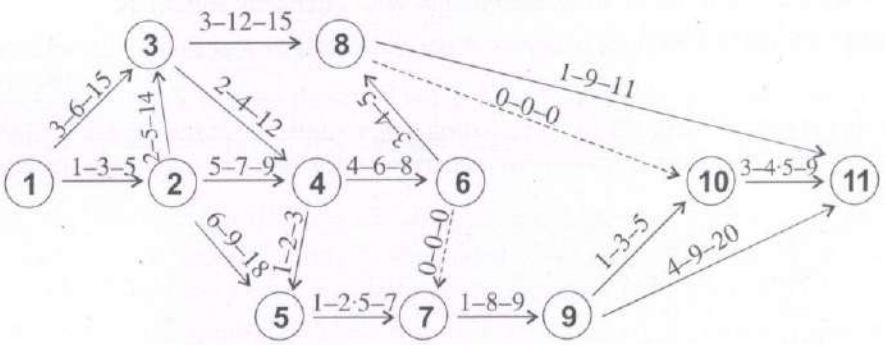


Fig-1. PERT NETWORK

2. (a) What are the differences between horizontal equivalent and contour interval? State the characteristics feature of contours plot.

   (b) Define the magnetic and true bearings of a line. Explain the term 'declination' and describe different types of variations in declination.

(c) While traversing in the field with compass, following bearings were observed:

Line	F·B	B·B
AB	45°45′	226°10′
BC	96°55′	277°5′
CD	29°45′	209°10′
DE	324°48′	144°45′

Determine the corrected bearings and check the correction also. (4+6)+(4+2+4)+12=32

3. (a) Give a neat sketch showing cross-sectional elements of a typical road in embankment, indicating Border line, Control line, Building line, Road land, Formation width, Road margin, Shoulder and carriageway. What are the purposes for providing Separator? State some of the forms of separator in which they are provided.

(b) Explain the terms:

(i) Prime Coat

(ii) Tack Coat

(iii) Surface Dressing (12+3+5)+(4×3)=32

4. (a) What is meant by aquifer? Explain various types of aquifer. An aquifer is 80 ha. in area. The water table is lowered by 10 m over whole area. If the porosity of the aquifer is 30% and the specific retention is 5%, calculate the amount of water which will be drained from the aquifer. Define 'storage coefficient'.

(b) Explain the objects for river training work. Name various types of such works. Explain the advantages and disadvantages of embankment in river training works.

(3+5+6+2)+(4+4+8)=32

5. (a) State the principle for deciding the capacity of a sedimentation tank for continuous flow. What are the overflow ratio for plain rectangular tank for different cases?

(b) What are the reasons for using coagulants during chemical sedimentation process? Name some of the commonly used coagulants with chemical equations.

(c) What are the differences between super chlorination and breakpoint chlorination?

(16+4)+(4+3)+5=32

6. (a) Name standard methods for forecasting population for water supply project. Population of a town, obtained from census department for consecutive three decades are shown below:

Year	Population
1990	12,000
2000	17,000
2010	23,500
2020	31,000

Estimate the population of the time for 2030 and 2040.

(b) Describe the desirable qualities of stones for building construction purposes.

(c) Specify the characteristics of a good mortar lime and cement.

(d) Explain the types of cement to be used for mass concrete and under water construction.

(4+12)+5+5+(3+3)=32

Group-B

Answer *any two* questions. 36×2=72

7. (a) State the differences between salvage value and scrap value.
   (b) Explain the importance and frequency of updating in completion of a project.
   (c) 30 kg of coarse aggregates were taken for sieve analysis. weight retained on 80 mm, 40 mm, 20 mm, 10 mm and 4·75 mm sieves, are 0, 1, 11, 10 and 8 kg respectively. Find the fineness modulus of the aggregate sample.
   (d) Write short notes on: 8+(5+3)+10+(5×2)=36
      (i) Rapid Hardening Cement
      (ii) Quick Setting Cement

8. (a) Name different methods for removal of temporary and permanent hardness of water.
   (b) What is meant by Refuse? What are different methods of disposal of refuse? Explain the method of waste disposal by composting.
   (c) Explain the following:
      (i) Wholesome water
      (ii) Palatable water
      (iii) Coliform Index 8+(2+4+16)+(2×3)=36

9. (a) State the basic principle of planning of roads.
   (b) What is meant by camber? Explain different types of camber.
   (c) Explain the functions of a transition curve. Name different types of such curves with sketches.
   (d) Describe cement concrete slab method of construction of concrete pavement, indicating placement of different joints in such pavement. What is CBR?
   (e) Define 'Group Index' and state use of group index in design of flexible pavement.
   4+(4+2)+(4+4)+(5+4+3)+(2+4)=36

10. (a) What is Lacy's ragime theory? Under what condition it is applicable?
   (b) What are the benefits of lined canal? Give one example of lining method of canal with neat sketch.
   (c) A city releases 5 mlD domestic sewage. Calculate the size of a circular type primary sedimentation tank for setting of suspended solids. Assume overflow rate as 16 m^3/m^2/day. Depth of the tank is 3·5 m. Check hydraulic retention time (HRT) and weir flowrate.
   (d) What is 'PAN' pollution? How is it formed? What are its effects? Describe the purpose and functions of cyclone separator with a neat sketch.
   (e) What is rotary signals? Describe with a neat sketch for a four (4) way skewed intersection.
   (3+2)+(3+3)+8+(2+2+2+5)+6=36

2021

COMMERCE AND ACCOUNTANCY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the language.*

Group-A

Answer *Question No.* 1 and *any one* from the rest.

1. (a) What is the role of financial system in economic development?
   (b) Describe the functions of intermediary financial institutions.
   (c) Give a brief sketch of financial market. 16+16+8=40

2. (a) (i) Define money and money market.
   (ii) Discuss features of developed money market.
   (b) State the feature of money market instruments. 16+16=32

3. (a) (i) Define capital market.
   (ii) Distinguish between capital market and money market.
   (b) Discuss the causes of price fluctuations of stock exchange.
   (c) Discuss the steps of trading of securities and methods of trading of securities in stock exchange. 16+8+8=32

4. (a) Discuss the various functions of Reserve Bank of India.
   (b) Explain the process of credit creation of commercial banks.
   (c) Explain the concept of money multiplier. 16+8+8=32

Group-B

Answer *any two* questions.

5. (a) Define contract.
   (b) What are the essential elements of contract?
   (c) State how offer is made, accepted and revoked.
   (d) State the circumstances in which a contract without valid consideration may be treated as valid. 4+12+8+8=32

6. (a) What are the objectives of Consumer Protection Act?

   (b) Define:
   - (i) Complaint
   - (ii) Goods and Services
   - (iii) Consumer
   - (iv) Dispute

   (c) Discuss about State Consumer Protection Council. 8+16+8=32

7. (a) Discuss the form and contents of the Articles of Association as per Companies Act, 2013.

   (b) (i) Briefly explain the 'Doctrine of Ultra Vires' under the Companies Act, 2013 with a relevant case study.

   (ii) What are the consequences of ultra vires acts of the company? 16+(8+8)=32

8. (a) Discuss the effects of mis. statements made in prospectus of company.

   (b) Discuss briefly the steps to be taken for formation of a Public Limited Company under the Companies Act, 2013.

   (c) Discuss the power and duties of Directors as per Companies Act, 2013. 8+16+8=32

Group-C

Answer *any one* question.

9. (a) "Audit is an instrument of financial control"— Explain.

   (b) Describe briefly what stapes you would take before commencing the detailed work of audit of a company.

   (c) What is audit working paper and what are its features? 8+16+8=32

10. (a) What is divisible profit?

   (b) Can dividend be declared without making good past losses?

   (c) What are the provisions of the Companies Act, 2013 regarding appointment and removal of Company Auditor? 6+10+16=32

Group-D

Answer *any one* question.

11. (a) Discuss the features and advantages of formal organisation.

   (b) (i) What is line and staff organisation?

   (ii) State the advantages and disadvantages of line and staff organisation.

   (c) Discuss Mcgregor's theory X and theory Y. 8+16+8=32

12. (a) Explain Maslow's Need Hierarchy theory.

   (b) Discuss Likert Management System of leadership. 16+16=32

2021

COMPUTER SCIENCE

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Answer *any five* questions.

1. (a) An identifier is defined as a sequence of letters and digits starting with a letter. Draw transition diagram for the identifier. 10

   (b) Define FIRST and FOLLOW sets. State the rules for computing them.

   Consider the grammar—

   $E \rightarrow TE'$

   $E' \rightarrow +TE' / \in$

   $T \rightarrow FT'$

   $T' \rightarrow *FT' / \in$

   $F \rightarrow (E) / id$

   where grammar symbols are conventional.

   Obtain the FIRST and FOLLOW sets. 5+5+10+10=30

2. (a) Draw a flowchart to describe working of Pass-I of a two-pass assembler. Describe the data structures used. 15+10=25

   (b) What do you mean by coupling and cohesion in a modular system? How are they related to good design? 8+7=15

3. (a) What is meant by a friend class? Give an example. 5+5=10

   (b) Distinguish between private and public access specifiers with examples. 10

   (c) What is a constructor? State the rules for creating a constructor in C++. What is default constructor? 6+10+4=20

4. (a) Describe different addressing modes of Intel 8085. 15

   (b) Explain the following: 10

   (i) MVI (ii) SHLD (iii) DAA (iv) RLC (v) PCHL

   (c) Write an Intel 8085 assembly language program to accomplish the following: 15

   Add the two 8-bit numbers 98H and 9AH in the memory location in 2501H and 2502H respectively and store the results in 2503H and 2504H. 2503H contains LSBs of sum and 2504H contains MSBs of sum.

   Explain the working.

5. (a) Design an E–R diagram for airline reservation system consisting of flights, aircrafts, airports, fares, reservations, tickets, pilots, crew and passengers. Clearly highlight the entities, the relationship, the primary keys and the mapping constraints. 20

   (b) Consider the following database schema:

   SUPPLIER (Sid, Sname, Saddress)

   CUSTOMER (Cid, Cname, Cadd, Cbalance)

   ITEM (Ino, Iname, Icolour, Iprice)

   ORDER (Sid, Cid, Ino, Qty, Qno)

   Answer the following SQL queries: 12

   (i) List names of all suppliers who have supplied at least one red item or at least one green item.

   (ii) List the supplier-id, name of all suppliers, who have supplied all items ordered by 'ANIL'.

   (c) Explain 3NF, 2NF with suitable example. 8

6. (a) Explain simple paging and simple segmentation. What are the advantages of segmentation over paging? 5+5=10

   (b) Give a formal definition of Deadlock. Mention the form necessary conditions for a deadlock to occur. Distinguish between Starvation and Deadlock. 5+8+7=20

   (c) Assume a fixed frame allocation for a process of three frames. The execution of the process requires reference to five distinct pages. The page address stream formed is

   2 3 2 1 5 2 4 5 3 2 5 2

   Determine the number of page faults for the following page replacement algorithms. Explain your answer.

   (i) Optimal policy (ii) LRU (iii) FIFO 10

7. (a) What is Cache coherence? Explain the coherence protocol. 5+10=15

   (b) The access time of Cache memory is 50 ns. and that of the main memory is 500 ns. It is estimated that 80% of the main memory requests are for read and the remaining are for write. The hit ratio for read access only is 0.9 and a write-through policy is used.

   (i) Determine the average access time considering only the read cycle.

   (ii) What is the average time if the write requests are also taken into consideration? 10

   (c) Describe the OSI network architecture proposed by ISO. Discuss briefly the functions of each layer. 15

8. Write short notes on (*any four*) : 10×4=40

   (a) Process control block

   (b) Spooling

   (c) Remote procedure call

   (d) Demand paging

   (e) Bresenham's line drawing algorithm

   (f) Interrupts

2021

ECONOMICS

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and the same language.*

Group-A

Answer *any three* questions.

1. The nature of economic growth in India is described as jobless growth. Do you agree with this view? Give arguments in favour of your answer. 2+38=40

2. What do you understand by the term 'Economic-Drain'? To what extent were the Britishers justified in drawing India her wealth and resources. Why were not the Indians able to stop the loot? 10+20+10=40

3. What do you understand by poverty in the Indian context? Discuss the poverty alleviation programmes undertaken during India's five year plans. 20+20=40

4. Discuss the future outlook on environment with particular reference to Sustainable development. 40

5. Make out a case for economic planning for an underdeveloped country. Discuss the importance of economic planning in a developing country. 20+20=40

Group-B

Answer *any two* questions.

6. Discuss the role of land reforms in agricultural development. Identify the factors that were responsible for the success of land reforms in India. 25+15=40

7. ''Public Sector in India is a mixed bag of failures and successes.'' —Explain. 20+20=40

8. Discuss the recent performance of West Bengal economy indicating the major initiatives taken by the West Bengal Government to make it as industrial destination. 40

———

2021

ELECTRICAL ENGINEERING

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and the same language.*

Answer *any five* questions.

1. (a) A six pole wave wound DC generator has 520 armature conductors. The armature current is 220 A. Find the armature reaction demagnetizing and cross magnetizing $A\tau$/Pole if (i) brushes are placed along the GNA (ii) brushes are shifted by 5 electrical degrees from the GNA. 15

   (b) A 230 V DC shunt motor runs at 1200 rpm at no load and takes 4 Amp. The armature and shunt field resistances are 0.1 Ω and 200 Ω, respectively. Calculate speed of the motor when loaded to take 40 Amp if armature reaction, weakens the field by 4%. 15

   (c) Why brushes in DC machine are made of Graphite? 10

2. (a) A 5 kVA, single phase transformer has core loss of 40W and full load copper loss of 100 W. The daily load variations of the transformer is as follows:

   7 AM – 1 PM = 3 kW at 0.6 p.f

   1 PM – 6 PM = 2 kW at 0.8 p.f

   6 PM – 1 AM = 6 kW at 0.9 p.f

   1 AM – 7 AM = No load.

   Determine all day efficiency of the transformer. *15*

   (b) A 415V, four pole, 50Hz, three phase star connected induction motor has per phase stator impedance of $Z_1 = (0.06 + J0.2)$ Ω per phase and rotor impedance referred to stator of $Z_2 = (0.07 + J0.4)$ Ω per phase. The per phase magnetizing reactance is 10 Ω and resistance representing core loss is 40 Ω. The slip is 3.6%. Calculate (i) stator current and stator power factor and (ii) developed torque. 15

(c) Derive the expression for the ratio of torque T at any slip to the maximum torque T_m of a three phase induction motor. 10

3. (a) A 100 MVA, 33 kV, 3-phase generating unit has a subtransmit reactance of 14%. The generator is connected to the motors through a transmission line and transformers as shown in Fig.-1. The motor have rated inputs 30 MVA, 20 MVA, 50 MVA at 30 kV and 20% subtransmit reactance. The 3-phase transformers are rated at 110 MVA, 32 kV/110 kV, Δ–Y with leakage reactance 7.5%. The line has a reactance of 50 Ω selecting the generator circle. Determine the base quantities in the generator circle, determine the base quantities in other parts of the system and calculate the corresponding per unit values. 15

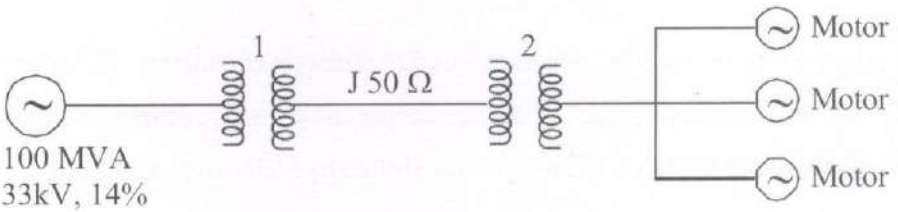


Fig.–1

(b) A conductor with 2.5 cm diameter is passed centrally through a porcelain bushing $\varepsilon_r = 4$ having internal and external diameters of 3 cm and 4 cm, respectively. The voltage between the conductor and an earthed clamp surrounding the porcelain is 20 kV rms. Determine whether corona will be present in the air space around the conductor. 15

(c) Calculate the voltage at a distance of 200 m of a 300 m long distributor uniformly loaded at the rate of 0.75 A per metre. The distributor is fed at one end at 250 V. The resistance of the distributor (go and return) per metre is 0.00018 Ω. Also find the power loss in the distributor. 10

4. (a) In a 33 kV overload line, there are three units in the string of insulators. If the capacitance between each insulator pin and earth is 11% of self-capacitance of each insulator, find (i) the distribution of voltage over three insulators and (ii) string efficiency. 20

(b) Determine the Inductance of a three phase symmetrical transmission line. 20

5. (a) Determine the A, B, C, D constants of a Medium transmission line. (use Nominal T model). 20

(b) Determine the bus admittance matrix Y_{Bus} for a five bus system shown in Fig-2. Assume that the shunt admittance at the buses and mutual couplings between the lines are neglected. 20

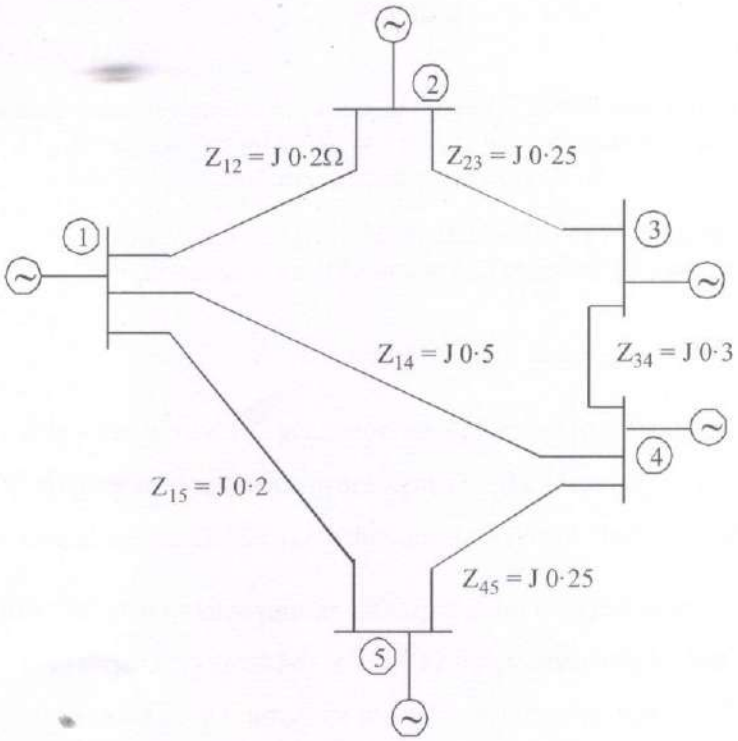


Fig.–2

6. (a) A 500 V series motor has an armature resistance of 0.4 Ω and series field resistance of 0.3 Ω. It takes a current of 100 A at a speed of 600 rpm. Find the speed of the motor if a divertor of resistance 0.6 Ω is connected across the field, the load torque being constant. Neglect armature reaction and assume that flux is proportional to the current. 20

(b) A resistance oven employing nichrome wire is to be operated from 220 V single phase supply and is to be rated at 16 kW. If the temperature of the element is to be limited to 1170°C and the average temperature of the charge is 500°C, find the diameter and length of the element wire. Radiating efficiency = 0.57, Emissivity = 0.9, Specific resistance of nichrome = 109×10^{-8} Ωm. 20

7. (a) Explain in details the types of energy audit to be performed depends on which factors. Also explain the classification of energy audit. 20

(b) Explain clearly the different instruments used for Energy Audit. 20

8. Write short notes on the following: 10×4=40

(a) What is a Sub-station? Classify Sub-station on the basis of service requirement.

(b) Describe the operation of Distance or Impedance relay.

(c) Write in details the desirable characteristics of Electrical tariff.

(d) Explain with a neat diagram the Merz-price protection scheme of an alternator.

2021

GEOGRAPHY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

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

1. Give a detailed account of the Climate of India. Explain the impact of climate change on the Indian Economy. 25+15=40

2. Discuss the various measures taken up for the development of agriculture in India during the plan periods. Bring out the relationship between green revolution and food self-sufficiency in India. 20+10=30

3. Divide India into Railway zones. Explain the importance of each zone with particular reference to resource use. 10+20=30

4. Give an account of the growth of urban population in India since Independence highlighting on metropolitan growth. Enumerate the measures taken by Government of India for development of urban areas. 20+10=30

5. Give an account of the non-conventional sources of energy used in India. Discuss their future prospects. 20+10=30

Group-B

Answer Question No. 6 *and* any two *from the rest.*

6. Give a reasoned account of the growth and distribution of population in West Bengal with suitable sketches. Discuss the measures taken for the development of marginalized sections of population in West Bengal. 30+10=40

7. Account for the growth and development of Jute Textile Industry in West Bengal. Discuss the major problems faced by this industry and measures taken to mitigate them. 15+15=30

8. Bring out the differences in the drainage pattern between the rivers of North and South West Bengal. Discuss the major causes of floods in West Bengal. 20+10=30

9. Bring out the pattern of Urbanisation in West Bengal with suitable examples. Account for the sudden increase in census towns in West Bengal in 2011 census. What measures have been taken for the development of small towns in West Bengal? 10+10+10=30

10. Bring out the significance of the strategic position of West Bengal with its neighbouring countries. Highlight on the West Bengal–Bangladesh border enclaves and their problems. 15+15=30

2021

GEOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. Answer the following: 8×5=40

   (a) With suitable examples, discuss the causes behind and effects of (i) pleochroism and (ii) birefringence in minerals.

   (b) Enumerate any two types of twinning in minerals with neat sketches and examples.

   (c) Discuss in short the different physical characteristics used for recognition of minerals.

   (d) Comment briefly on the acute bisectrix interference figure of biaxial minerals.

   (e) Explain why in any igneous rock primary forsterite and quartz can not stably coexist.

2. (a) Discuss briefly the classification of silicate structures of minerals.

   (b) Describe with a diagram the approximate limits of solid solution in the feldspar group of minerals.

   (c) Discuss briefly on the general diagnostic physical and optical properties of the Pyroxene group of minerals. 15+15+10=40

3. (a) Give a brief account on the utility of ACF and AKF diagrams.

   (b) In a P – T diagram, show the domains of various metamorphic facies and briefly explain these facies.

   (c) Explain the two important types of metamorphism and their effects. How would you relate metamorphism and tectonics? 10+15+15=40

4. (a) Give a brief account on the classification of carbonate rocks giving emphasis on their depositional condition.

   (b) Describe the different primary depositional sedimentary structures that can be used for determining palaeocurrent directions. Draw sketches to explain your answer.

   (c) Discuss the significance of grain size in the studies of sedimentary rocks. 15+15+10=40

5. (a) Draw the diagram of Mg_2SiO_4—Fe_2SiO_4—SiO_2 and write its implication in the crystallization of basic magma.

   (b) Distinguish between concordant and discordant bodies of igneous rocks. What are dykes and sills and how they are formed? Illustrate the following with block diagrams: batholith, laccolith and lopolith.

   (c) With the help of neat sketches show the indicatrix diagram for the positive and negative biaxial minerals. 15+15+10=40

Group-B

Answer *any two* questions.

6. Answer the following questions: 8×5=40

   (a) Give an account of distribution of hydrocarbon resources of India.

   (b) Give an account of coal deposits of West Bengal.

   (c) Comment briefly on the environmental impact of Open Cast Mining.

   (d) What do you understand by the terms 'Cut-off grade', 'Tonnage', 'Clarke value' and 'Enrichment Factor'?

   (e) Discuss the climatic change-record during Pleistocene from Indian geologic formations.

7. (a) What is 'Tenor' of an ore? What are 'Assay width' and 'Average width' of an ore body? State different methods of mine sampling. How does sampling help in determination of ore reserve?

   (b) With suitable examples, define indicator and pathfinder elements in geochemical prospecting.

   (c) Explain how ore concentrations are produced from run-off mine by mineral beneficiation. 15+10+15=40

8. (a) Explain the geological setting and origin of petroleum bearing Reservoir rocks in Bombay High.

   (b) Describe effects of long term application of nitrate fertilizers on ground water regime.

   (c) What are the raw materials used in cement industry? Describe briefly the geology of cement grade limestones deposits in India. 15+10+15=40

2021

HISTORY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

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

1. Answer *any one*:
   (a) Analyse the reasons for the introduction of the Permanent Settlement in Bengal in the light of the debate amongst the scholars. 20
   (b) Discuss the salient features of 'Constructive Swadeshi' in the context of Swadeshi movement in Bengal. 20
   (c) Write an essay on the peasant uprisings in pre-1857 Bengal. 20
2. Do you subscribe to the view that the 'safety valve' theory for the foundation of the Indian National Congress was a myth? What was the reality behind it? 40
3. Explain how women's organizations emerged in colonial India. Discuss the achievements of the All-India Women's Conference with special reference to the child marriage reform issue. 40
4. Identify the basic features of India's foreign policy in the Nehru-era. Examine India's relations with her neighbours during this time. 40

Group-B

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

5. Answer *any one*:
   (a) How would you estimate the Reign of Terror in revolutionary France? 20
   (b) Why were France and Germany backward than England in the march of Industrial Revolution? 20
   (c) In what ways did Mazzini contribute to the cause of Italian unification? 20
6. Account for the rise of New imperialism. What was its impact on Africa? 40
7. Examine the salient features of the policy of appeasement. To what extent was it responsible for the outbreak of the Second World War? 40
8. Explain the role of the United Nations as the peace maker in the world in the second half of the twentieth century with special reference to its role in the Congo and Korean crises. 40

Group-B

Answer *question no.* 7 and *any three* from the rest of the Group-B.

7. Write short notes on *any four* of the following: 5×4=20

   (a) Ratification

   (b) Consideration

   (c) Cross offer

   (d) Coercion

   (e) Contingent Contract

   (f) Wagering Agreement

8. (a) What are the essential elements of a valid contract? What is the standard form of a contract? 10

   (b) What is Proposal? When the communication of a proposal is complete? What are the modes of revocation of a proposal? 10

9. (a) "All contracts are agreements but all agreements are not contracts."— Discuss. 10

   (b) Differentiate between mistake of fact and mistake of law. 10

10. (a) What is 'Doctrine of frustration'? Cite three illustrations. 10

    (b) What is Novation of a contract? Explain the Doctrine 'Quantum Meruit'. 10

11. (a) What is the difference between contract of indemnity and contract of guarantee? 10

    (b) What is Bailment? What are the duties of a Bailee? 10

12. (a) What is an agency? How is an agency created? 10

    (b) Who is a substituted agent? When is an agency terminated? 10

Group-C

Answer *question no.* 13 and *any one* from the rest of the Group-C.

13. Write short notes on *any four* of the following: 5×4=20

    (a) Expert Opinion

    (b) Res gestae

    (c) Oral Evidence

    (d) Dying Declaration

    (e) Primary Evidence

    (f) Secondary Evidence

14. (a) What are 'May Presume', 'Shall Presume' and 'Conclusive Proof'? 10

    (b) Define fact. What is the difference between 'Fact in issue' and 'Relevant fact'? 10

15. (a) What is the difference between 'Admission' and 'Confession'? 10

    (b) What is the evidenciary value of confession? 10

2021

MANAGEMENT

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Answer *any five* questions.

1. What is a Product Lifecycle? Suggest (i) Pricing and (ii) Distribution Strategies for a Luxury Durable Product in different stages of its lifecycle. 10+15+15=40

2. (a) Why is an opinion leader a more credible source of product information than an advertisement for the same product?

   (b) Elaborate on circumstances in which information from advertisements is likely to be more influential than word-of-mouth. Illustrate with examples.

   (c) How is this specially relevant for a service in comparison to a product? 15+15+10=40

3. (a) In the context of PERT analysis what is meant by Optimistic, Pessimistic, Most Likely Time?

   (b) With reference to Critical Path Method analysis what is meant by Total Float, Free Float and Independent Float?

   (c) Differentiate between Slack and Float and its utility in decision making. 15+15+10=40

4. A baker specialises in two particular types of cake, plain and sponge. One plain cake requires 200g of flour and 25g of fat, and another kind, sponge cake requires 100g of flour and 50g of fat. Find the maximum number of cakes that can be made from 5kg of flour and 1kg of fat assuming that there is no shortage of the other ingredients, used in making the cakes. Find the maximum number of cakes that can be baked. Formulate the appropriate LPP and solve it graphically. 15+10+15=40

5. Calculate Operating Leverage and Financial Leverage under situation 1 and 2 in Financial Plans A & B from the following information relating to the Operation and Capital Structure of a company.

   Installed Capacity – 2,000 units

   Actual Production and Sales – 50% of the capacity

   Selling Price – Rs. 20 per unit, Variable Cost Rs. 10 per unit

   Fixed Cost – Under Situation I Rs. 4,000, Under Situation II Rs. 5,000

Situation I and II can be financed by Financial Plan A and B.

Capital Structure:

Financial Plans:

	A (Rs.)	B (Rs.)
Equity	5,000	15,000
Debt (Rate of Interest 10%)	15,000	5,000
Total	20,000	20,000

20+10+10=40

6. Write short notes on (*any four*): 10×4=40

   (a) BCG matrix

   (b) SWOT analysis

   (c) Quality circle

   (d) 7 Ps of Services Marketing

   (e) Employee Grievance Cell

7. (a) What are the different sources of recruitment?

   (b) Differentiate between recruitment and selection.

   (c) Discuss the importance and process of human resource planning in a large organisation.

   10+10+20=40

8. (a) What is the difference between Equity and Debt Capital? Illustrate with example the appropriate situation when a company may use debt or equity capital.

   (b) Discuss Budget as a tool of financial control. (10+15)+15=40

2021

MATHEMATICS

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any five* questions.

1. (a) If $Z_n = \cos\frac{\pi}{2^n} + i\sin\frac{\pi}{2^n}$, Prove that $\lim_{n\to\infty}(Z_1 Z_2 Z_3 \ldots\ldots Z_n) = -1$. 14

   (b) Solve $x^4 + 12x - 5 = 0$ by Ferrarie's Method. 14

2. (a) If a, b, c are three +ve numbers and $a + b + c = 1$, then prove that

   $$\left(a+\frac{1}{a}\right)^2 + \left(b+\frac{1}{b}\right)^2 + \left(c+\frac{1}{c}\right)^2 \geq 33\frac{1}{3}.$$ 14

   (b) If a and b are relatively primes, then prove that gcd $[(a+b),(a-b)] = 2$ or 1. 14

3. (a) Prove that every group of prime order is cyclic. How many generators are there of the cyclic group G of order 8? 10+4=14

   (b) Prove that the intersection of two ideals of R is an ideal of R. 14

4. (a) Prove that the function $f(x,y) = x^3 + 3x^2 + 4xy + y^2$ attains a minimum at the point $\left(\frac{2}{3}, -\frac{4}{3}\right)$. 14

   (b) Verify Green's Theorem in the plane for $\oint_C\{(x^2+xy)dx + xdy\}$, where C is the curve enclosing the region bounded by $y = x^2$ and $y = x$. 14

5. (a) Evaluate, by using suitable transformations $\iint x^2y^2dxdy$ extended over the region $x \geq 0, y \geq 0, x^2 + y^2 \leq 1$. 14

   (b) Let V be the closed region bounded by the surfaces $x = 0, x = 2, y = 0, y = 6, z = x^2, z = 4$ and $\vec{F} = y\hat{i} + 2x\hat{j} - z\hat{k}$. Find $\iiint_V \vec{\nabla} \times \vec{F}\, dV$. 14

6. (a) Define Complete Metric Space. Prove that every convergent sequence in a Metric Space is a Cauchy sequence.

   The space $C[0,1]$ of all bounded continuous real-valued functions defined in the closed interval [0,1] with the metric d. Prove that $d(f,g) = \max_{0\leq x\leq 1}|f(x) - g(x)|$ is a complete metric space. 2+4+8=14

(b) Show that an analytic function with constant modulus is constant. 14

7. (a) Use Picard's method to compute $y(0 \cdot 2)$ from the differential equation

$\frac{dy}{dx} = 1 + xy$, given $y = 1$ when $x = 0$. 14

(b) The value of Sin x are given below for different values of x. Form a difference table and from this table find Sin 32°. 14

x :	30°	35°	40°	45°	50°	55°
$y = \sin x$:	0 · 5000	0 · 5736	0 · 6428	0 · 7071	0 · 7660	0 · 8192

8. (a) Write an algorithm and draw a flowchart to determining a real root of the equation $f(x) = 0$ by Newton-Raphson's method. 4+10=14

(b) A committee consists of the Chairman, President, Secretary and Treasurer. A motion passes if and only if it gets a majority vote or the vote of the Chairman plus one other member. Each member presses a button to indicate approval of a motion. Design a switching circuit controlled by the buttons where the lamp glows if and only if a motion is approved. 14

Group-B

Answer *any two* questions.

9. (a) Let random variable X and Y have joint density function $f(x,y) = \begin{cases} e^{-x-y}, x, y > 0 \\ 0, \text{otherwise} \end{cases}$ and let $U = X + Y, V = \frac{X}{X+Y}$; find the joint distribution function of U and V. 12

(b) A group consists of 3 singers and 4 dancers, who attended a cultural programme. 3 of them at random took dinner in a family. If they were casually requested to sing-a-song, how could they honour their request? Prepare a distribution table. Find the mean and variance from the distribution. 6+6+6=18

10. (a) Obtain the regression coefficients and hence the correlation coefficients from the following data: 15+3=18

Height (in cm) :	135	140	145	150	155	160	165
Weight (in Kg) :	46	45	48	50	62	63	65

(b) A normal distribution is given, which has a mean 1·5 and variance 8. If a random sample of size 25 is drawn from that normal population, find the probability that the mean of the sample becomes positive. If again a sample of size 35 is drawn at random, what is the probability that the mean of the sample will be negative? 6+6=12

11. (a) Prove that the set of all feasible solutions to a linear programming problem is a closed convex set. Prove that $X = \left\{X = \frac{(x,y)}{|x|} \leq 2\right\}$ is a convex set. 12+4=16

(b) Find the optimal solution and corresponding cost of transportation in the transportation problem: 14

	D_1	D_2	D_3	D_4	a_i
O_1	19	20	50	10	7
O_2	70	30	40	60	9
O_3	40	8	70	20	18
b_j	5	8	7	14	

2021

MECHANICAL ENGINEERING

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and the same language. Any data if needed may be assumed, but it must be clearly mentioned.*

Answer *any five* questions.

1. (a) Explain the concept of PMM1 and PMM2 in thermodynamics. (6)

   (b) Air at 10°C and 80 kPa enters the diffuser of a jet engine steadily with a velocity of 200 m/s. The inlet area of the diffuser is 0·4 m^2. The air leaves the diffuser with a velocity that is very small compared to the inlet velocity. Calculate the mass flow rate of air and the temperature of the air leaving the diffuser. (14)

   (c) Two reversible heat engines are arranged in series. Engine A rejects heat directly to engine B. Engine A receives 200 kJ of heat at 421°C from a source, while engine B recjects heat to a sink at temperature of 4·4°C. If the work output of engine A is twice that of engine B, find (i) the intermediate temperature between engine A and engine B, (ii) the efficiency of each engine and (iii) the heat rejected to the cold sink at 4·4°C. (20)

2. (a) What do you mean by principle of increase of entropy? (6)

   (b) Calculate the entropy change of the universe as a result of the following processes: (i) A copper block of 600gm mass with C_p of 150 J/kg-K at 100°C is placed in a lake of 8°C, (ii) The same block at 8°C is dropped from height of 100m into the lake and (iii) Two such blocks at 100°C and 0°C are joined together. (14)

   (c) A parallel flow heat exchanger is used to cool alcohol from 66°C to 40°C using water entering at 5°C. The flow rates of alcohol and water are 55,000 kg/hr and 40,000 kg/hr respectively. Calculate the exit temperature of water, heat transfer rate and the required surface area of the heat exchanger. Take overall heat transfer co-efficient, U = 580 W/m^2-K, c_p (alcohol) = 3760 J/kg-K and c_p (water) = 4180 J/kg-K.

   Will there be any change in the surface area requirement if a counter flow heat exchanger is used for this cooling purpose? If so, find it. (20)

3. (a) Define radiosity, irradiation and view factor in connection with radiation heat transfer. Two parallel infinite plane surfaces are maintained at 200°C and 300°C respectively. Determine the net rate of radiation heat transfer per unit area when (i) the two surfaces are black and (ii) when the two surfaces are gray having emissivity of 0·8. (7+15=22)

(b) The exterior wall of a house consists of 10·16 cm thick layer of common brick having thermal conductivity 0·7 W/m-K. There is a 3·8 cm thick layer of gypsum plaster with thermal conductivity 0·48 W/m-K. What thickness of loosely packed rockwool insulation (k = 0·065 W/m-K) should be added to reduce the heat loss through the wall by 80%. (18)

4. (a) What do you mean by Lower Heating Value (LHV) and Higher Heating Value (HHV) of a fuel? For what purpose Orsat apparatus is used? Explain its working principle. (4+2+4=10)

(b) Show that the humidity ratio of moist air can be expressed as $\omega = 0{\cdot}622\frac{p_v}{p - p_v}$, where p_v and p are the partial pressure of water vapour and atmospheric pressure respectively. (10)

(c) Consider an ideal Rankine cycle where steam at 20 bar, 360°C is expanded in a steam turbine to 0·08 bar. Then it enters a condenser, where it is condensed to saturated liquid water. The pump feeds back the water into the boiler. Find per kg of steam the net work and the cycle efficiency. Also, calculate the percentage reduction in the network and the cycle efficiency if the turbine and the pump have 85% efficiency. Use of steam table is allowed. (20)

5. (a) What do you mean by chemically correct air fuel ratio? In this connection, explain the terms : lean mixture and rich mixture and equivalence ratio. Sketch the variation of requirement of air fuel mixture of a SI engine over its entire operating range. Mark the different regimes of operation. (2+6+8=16)

(b) An engine working on Otto cycle has a volume of 0.5 m^3, pressure of 1 bar and temperature of 27°C at the start of the compression process. The pressure becomes 10 bar at the end of the compression stroke. If the heat addition during the isochoric process is 200 kJ, determine the clearance volume as percentage of swept volume, efficiency of the cycle and the mean effective pressure. If the engine is a 4 stroke one and runs at 400 rpm, calculate the power developed. Take, $\gamma = 1.4$ for air. (16)

(c) Explain the terms : Cetane number and Octane number of IC engine fuel. What is the approximate value of Cetane number for commercially available diesel? (6+2=8)

6. (a) State the advantages of centrifugal pump over reciprocating pump. Explain the working of a centrifugal pump with the help of a neat sketch. (6+10=16)

(b) What do you mean by eco-friendly refrigerants? Name a few of them. (3+3=6)

(c) A simple saturated vapour compression refrigeration system works between evaporator temperature of –10°C and condenser temperature of 30°C using R-134a as the refrigerant. Calculate the COP of the system. Also, calculate the mass flow rate of the refrigerant, suction volume and power per ton of refrigeration. The relevant properties of R-134a are given below. The specific heat of R-134a vapour may be taken as 1.044 kJ/kg-K. (18)

Temp	P_{sat}(bar)	V_g(m^3/kg)	h_f(kJ/kg)	h_g(kJ/kg-K)	S_f(kJ/kg-K)	S_g(kJ/kg-K)
–10	2.0052	0.09963	186.78	392.75	0.9509	1.7337
+30	7.7008	0.02667	241.65	414.94	1.1432	1.7149

7. (a) A circular plate 4.5m in diameter is submerged in water. Its greatest and least depths below the water surface are 3m and 1.5m respectively. Calculate the total force on the front face of the plate and the position of centre of pressure. (16)

   (b) What do you mean by viscosity of a fluid? State the differences between dynamic viscosity and kinematic viscosity. What are their units in SI system? (2+4+2=8)

   (c) Explain the flow velocity measurement principle at any point in a pipe by Pitot tube. (6)

   (d) Derive an expression for head loss due to friction for pipe flow, in terms of coefficient of friction, pipe dimensions and flow velocity. (10)

2021

PHILOSOPHY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. State and explain the principles of justice following John Rawls. How does Rawls' view differ from Mill's in the context of justice? 20+20=40

2. Explain and examine Ambedkar's view of social change. 25+15=40

3. Discuss the meaning of Humanism. Explain the implication of Humanism in the present socio-political context. 20+20=40

4. Critically explain Strawson's concept of person. 40

5. Write short notes on the following: 20+20=40

   (a) Freud's proofs for the existence of the unconscious

   (b) Yoga view of *Citta* and *Cittavṛtti*

Group-B

Answer *any two* questions.

6. Explain the ideology of radical feminism. How do the radical feminists differ from the liberal ones? Discuss. 20+20=40

7. Explain and examine the theory of capital punishment. 20+20=40

8. Bring out the significance of the relation between religion and morality. 40

2021

PHYSICS

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *but all answers must be in one and same language.*

Group-A

Answer *any six* questions.

1. (a) Explain the concept of wave particle dualism. If matter has a wave nature, why is this wavelike character not observable in our daily experiences?

   (b) Calculate wavelength of the de Broglie wave associated with an electron having a kinetic energy of 100 eV. (3+2)+5=10

2. (a) State and explain Heisenberg's uncertainty principle. Using the concept of wave packet obtain approximately the uncertainty relation regarding position and momentum.

   (b) Applying uncertainty principle, prove that a free electron cannot exist in an atomic nucleus. (3+2)+5=10

3. Explain with the help of a block diagram the working principle of a feedback amplifier and hence find out an expression for voltage gain with feedback. What are the advantages of negative feedback? 7+3=10

4. (a) State and explain Pauli's exclusion principle. Apply it to determine the maximum number of electrons that can exist in K, L, M and N shells.

   (b) For the electronic transition $^1D_2 \rightarrow {}^1P_1$, draw the energy level diagram to show Zeeman splitting of energy levels $^1D_2$ and $^1P_1$ in presence of magnetic field. Also show all allowed transitions. (2+4)+4=10

5. (a) Derive an expression for the canonical partition function.

   (b) Consider a system whose three energy levels are given by 0, ϵ, and 2ϵ. The energy level ϵ is two-fold degenerate while the other two are non-degenerate. Find the partition function of the system. 5+5=10

6. (a) State and derive Bragg's law for X-ray diffraction by crystal planes.

   (b) X-rays with 1·54Å are used for the calculation of the d_{100} plane of a cubic crystal. The Bragg's angle of the first order diffraction is 10°. What is the size of the unit cell? 5+5=10

7. (a) Draw a graph of binding energy per nucleon versus mass number and explain the important features of the graph. Explain nuclear fusion from the binding energy graph with an example.

   (b) For each of the following decays state a conservation law that forbids it: (3+3)+4=10

   (i) $n \rightarrow p + e^-$

   (ii) $n \rightarrow \pi^+ + e^-$

   (iii) $n \rightarrow p + \pi^-$

   (iv) $n \rightarrow p + \gamma$

8. (a) What is Q-value of nuclear reaction? How can it be determined?

   (b) Find the mass of ${}_6C^{14}$ (in amu) from the following nuclear reaction:

$$ {}_7N^{14} + {}_0n^1 = {}_6C^{14} + {}_1H^1 + 0{\cdot}55\text{MeV} $$

   Given that the mass of proton = 1·00758 amu, mass of neutron = 1·00898 amu, mass of ${}_7N^{14}$ =14·00752 amu and 1 amu = 931 MeV. (2+3)+5=10

9. Distinguish between dia–, para– and ferromagnetic materials. Derive the Curie–Weiss law of ferromagnetism. 5+5=10

Group-B

Answer *any seven* questions.

10. (a) Starting from the time-dependent Schrödinger equation, deduce the time-independent Schrödinger equation for three dimensional motion.

    (b) What are stationary states? Why are they so called?

    (c) Find the expectation values $< x >$ and $< x^2 >$ for a Gaussian packet given by

$$ \psi(x) = \left(\frac{1}{\sigma\sqrt{\pi}}\right)^{\frac{1}{2}} \exp\left(\frac{-x^2}{2\sigma^2}\right) \exp(ik_0 x) $$ 5+(2+3)+(5+5)=20

11. (a) Obtain the energy eigenfunctions of a particle trapped in a one dimensional box of length L. Sketch the ground state and first excited state eigenfunctions with their probability densities.

    (b) Show that the eigenfunctions are orthogonal to one another.

    (c) Find the probability that the particle can be found between 0·45L and 0·55L for the ground state. (6+4)+5+5=20

12. (a) Find the minimum magnetic field needed for the Zeeman effect to be observed in a spectral line of 400 nm wavelength when a spectrometer of resolution 0·010 nm is used. Derive the necessary formula used in the calculation.

    (b) Find out whether the transitions ${}^2D_{\frac{3}{2}} \rightarrow {}^2P_{\frac{3}{2}}$ and ${}^2D_{\frac{3}{2}} \rightarrow {}^2S_{\frac{1}{2}}$ are forbidden or allowed by the selection rules.

    (c) What are Stokes' and anti-Stokes' lines? (4+6)+(3+3)+4=20

13. (a) Explain MB, FD and BE statistics, especially about their differences. How do the FD and BE distributions tend to MB distribution?

(b) Three identical particles are to be distributed in three states. What are the number of possible ways of distributing them according to MB, FD and BE statistics?

(c) Calculate the Fermi energy in electron volts for sodium assuming that it has one free electron per atom. Given that the density of sodium = 0·97 g cm^{-3} and atomic weight of sodium = 23.

(5+4)+5+6=20

14. (a) Obtain an expression for Planck's formula in terms of frequency for black-body radiation, using BE statistics.

(b) A system of two energy levels E_0 and E_1 is populated by N particles at temperature T, following classical distribution law.

(i) Derive an expression for the average energy per particle.

(ii) Derive an expression for the specific heat of the system. 10+(5+5)=20

15. (a) What are Miller indices? Show that the spacing between consecutive planes defined by Miller indices $(h\ k\ l)$ is given by $d_{hkl} = \left[\frac{h^2}{a^2} + \frac{k^2}{b^2} + \frac{l^2}{c^2}\right]^{-\frac{1}{2}}$.

(b) Find the possible values of the total angular-momentum quantum number J under LS coupling of two atomic electrons whose orbital quantum numbers are $l_1 = 1$ and $l_2 = 2$.

(c) A particle of energy E is incident of a rectangular potential barrier of width a and height V_0 when $E < V_0$. Find out the transmission coefficient. (3+4)+3+10=20

16. (a) Explain the classification of solids into conductors, semiconductors and insulators on the basis of band theory.

(b) The energy gap in silicon is 1·1 eV and in diamond it is 6 eV. State the transparency of these substances to visible light.

(c) Define superconductivity. Explain the effect of an external magnetic field on the superconducting state of a material. 6+6+(2+6)=20

17. (a) What are the essential features of the liquid-drop model of the nucleus? Indicate what properties of the nucleus are well predicted by this model.

(b) The nuclear binding energy may be approximated by the empirical expression

$$B.E. = a_1 A - a_2 A^{\frac{2}{3}} - a_3 \frac{Z(Z-1)}{A^{\frac{1}{3}}} - a_4 \frac{(A-2Z)^2}{A}$$

where the symbols have their usual meanings. Explain the various terms in the expression.

(c) Considering a set of isobaric nuclei, derive a relationship between A and Z for the most stable isobar. (6+4)+6+4=20

18. (a) Simplify the following Boolean expressions:

(i) $(A+B)(\bar{A}+C)(B+C)$

(ii) $(\bar{A}+B)(A+\bar{B})+\overline{(\bar{A}\bar{B})(A\bar{B})}$

(b) Design a logic circuit to implement the following Boolean expression:

$$Y = A.B.C + A.(\bar{B}+\bar{C})$$

(c) Realize the following function using only (i) NAND gates and (ii) NOR gates: $Y = (A+C)(\bar{A}+B)$ (3+3)+4+(5+5)=20

19. (a) What ate the differences between a JFET and a BJT?

(b) An n-channel JFET has $I_{DSS} = 12mA$ and pinch-off voltage $V_p = -4V$. Find the drain current for $V_{GS} = -2V$, If the transconductance g_{mo} of a JFET with the same I_{DSS} at $V_{GS} = 0$ is 4 millimho, find the pinch-off voltage.

(c) Draw a circuit diagram of a differentiator using an OP AMP. Derive an expression for the output voltage. 5+(3+4)+(4+4)=20

2021

PHYSIOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and the same language.*

Group-A

Answer *any six* questions.

1. (a) Give a brief account of the ultrastructure of the skeletal muscle fiber with a schematic diagram.
   (b) What is sarcotubular system? Name its different components. (8+4)+(4+4)=20

2. Explain the following properties of nerve fibers: 5×4=20
   (a) All-or-none response
   (b) Refractory period
   (c) Indefatiguability
   (d) Accommodation

3. (a) Name the different layers of the cerebral cortex.
   (b) Mention the location of pyramidal cells in the human brain.
   (c) Briefly describe the histological section of the spinal cord with a neat labelled diagram. 6+2+(6+6)=20

4. (a) Describe the structure of the middle ear.
   (b) Discuss the functions of the middle ear as an acoustic transformer.
   (c) Name the receptors for hearing. 6+10+4=20

5. (a) What are myopia and hypermetropia?
   (b) Mention the causes for these abnormalities.
   (c) How can they be rectified? (2+2)+(4+4)+(4+4)=20

6. (a) Distinguish between: somatic reflex and autonomic reflex.
   (b) What do you mean by consolidation of memory?
   (c) Mention the stages of non- REM sleep. 8+6+6=20

7. (a) What is the normal body temperature of an adult human?
   (b) State the concept of 'set point' for temperature control.
   (c) What are the physical processes of body temperature regulation? 2+8+10=20

8. (a) Discuss the role of GH on cellular metabolism.
   (b) Mention the abnormalities caused by hypoactivity and hyperactivity of GH before and after puberty. 12+8=20

9. (a) Compare the histological structure of euthyroid, hyperthyroid and hypothyroid gland with diagram.
   (b) Name the hormones released by thyroid gland.
   (c) Discuss about the calorigenic functions of thyroid hormone.
   (d) What is reverse T_3? (6+3)+3+6+2=20

10. (a) Draw a labelled histological structure of the testis.
    (b) Outline the steps of spermatogenesis with a schematic diagram. 6+14=20

Group-B

Answer *any four* questions.

11. (a) Classify nerve fibers.
    (b) What is Wallerian degeneration?
    (c) What is transneuronal degeneration?
    (d) What do you mean by superficial and deep reflexes? 8+4+4+(2+2)=20

12. (a) Describe with a neat diagram the origin, course and termination of corticospinal/ pyramidal tract.
    (b) What do you mean by upper motor neurone and lower motor neurone? (4+12)+(2+2)=20

13. (a) Discuss briefly the physiological basis of light accommodation in the human eye.
    (b) Describe with a diagram the histological structure of the olfactory neuroepithelium. 12+(2+6)=20

14. (a) What is insensible perspiration?
    (b) What is sebum?
    (c) Discuss briefly the functions of the skin. 4+4+12=20

15. (a) Why posterior pituitary is known as neurohypophysis?

(b) Write a brief note on 'milk ejection reflex'.

(c) In the light of functional aspect, discuss the significance of the name 'Antidiuretic Hormone'.

(d) Mention one function of oxytocin in male body. 2+8+8+2=20

16. (a) Mention the names and origin of hormones regulating calcium homeostasis.

(b) Give a brief account of their function in maintenance of normal calcium levels in blood.

8+12=20

2021

POLITICAL SCIENCE

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answers may be given either in ***English*** *or in* ***Bengali*** *or in* ***Nepali*** *but all answers must be in one and same language.*

Group-A

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

1. Answer *any five* from the following: 8×5=40
   (a) Discuss briefly the concept of 'Development Administration' with reference to its basic features.
   (b) Enumerate the various forms of decentralisation.
   (c) Write a short note on the determining factors of decision-making process.
   (d) Discuss the legacy of British rule in post-colonial Indian administration.
   (e) What are the major recommendations of the Administrative Reforms Commission (ARCII), 2005?
   (f) What are the functions of the Cabinet Secretary in Union administration?
   (g) Briefly discuss the training procedures of the members of All-Indian Services.

2. Critically evaluate the major areas of public grievances towards various spheres of administration and assess the methods to promote good relations between citizens and administration. 30

3. Examine the importance of 'Decision Making' in administrative process with special reference to Herbert Simon's 'Behaviour Alternative Model'. 30

4. Do you think that globalisation has radically impacted the nature and scope of public administration? —Justify. 30

Group-B

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

5. Answer *any five* from the following: 8×5=40
   (a) Discuss the various techniques deployed to ensure 'balance of power'.
   (b) What are the types of 'New Diplomacy' prevalent in present-day International Relations?
   (c) Briefly explain the instruments of neo-colonialism.

(d) Do you think that NAM is still relevant today? Explain your arguments fully.

(e) 'UNO needs reforms'— Justify your answer with relevant examples.

(f) Comment on the role of public opinion in restraining the actions of states in International Relations.

(g) Write a note on recent Indo-China border tranquility Agreement.

6. Write an overview of international terrorism and also discuss the various mechanisms to combat International terrorism. 30

7. Discuss the features of the International system in the Post-Cold War era. 30

8. Analyse the current International order in the light of challenges posed through Human Rights issues and Environmental threats. 30

2021

PSYCHOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

The figures in the margin indicate marks for each question.

Group-A

Answer *any three* questions.

1. Explain the meaning of 'Ego Psychology' as enunciated by Eric Erikson. Write what you know about "man's eight stages of ego development" as put forward by Erikson. 10+30=40

2. What is a 'psychological test'? Discuss the characteristics that must be there in a good psychological test. What are the major categories of tests in the field of psychology? 6+26+8=40

3. Distinguish between 'distress' and 'eustress'. Examine the nature of relationship between distress and physical health. What is coping behaviour? State the names of at least three such. 10+20+6+4=40

4. What is meant by motivation? Discuss the two well known theories of motivation as put forward by Herzberg and Alderfer. 10+30=40

5. Write notes on *any two*: 20+20=40

   (a) Nature-Nurture controversy

   (b) Causes of abnormal behaviour

   (c) Client-centered therapy

   (d) Research variables and their control

Group-B

Answer *any two* questions.

6. Define a 'group'. Delineate the structure of a group. Discuss the special characteristics of a family as a primary group in society. 8+16+16=40

7. Differentiate crime from delinquency. Discuss the causes of delinquency in society. 10+30=40

8. Write notes on *any two*: 20+20=40

   (a) Parametric and Non-parametric statistics

   (b) Personnel Selection and Job Analysis

   (c) Psychosocial problems related to old age

   (d) Substance abuse disorders

2021

SOCIOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

Answer *any three* questions.

1. Narrate the distinctive features of unity as well as diversity in the perspective of Indian society and culture. 40

2. Discuss, in brief, any two environmental movements in India. 40

3. Discuss the process of integration of various linguistic groups in the main stream of contemporary Indian society. 40

4. Distinguish between caste and tribe. Give a historical account of tribal welfare in India since independence. 10+30=40

5. What do you understand by gender socialization? 'Gender bias is visibly evident even in the 21st Century.'— Explain in the context of Indian society. 10+30=40

Group-B

Answer *any two* questions.

6. How do you conceptualize secularism? 'Contemporary Indian society is a secular society.'— Discuss. 40

7. Discuss the demographic, educational and occupational profiles of the youth in India today. 40

8. Is drug addiction a social problem? Explain. 40

2021

STATISTICS

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

*Answers may be given either in **English** or in **Bengali** but all answers must be in one and same language.*

Group-A

1. Answer *any ten* questions: 10×10=100

(a) What is a 'C' chart? When is it used?

(b) Define Fisher's Ideal Index Number. Show that it lies between Laspeyre's and Paasche's Index Numbers.

(c) What is the rationale behind using 3 Sigma Control Limits?

(d) Describe 3 criteria for detecting lack of control in $\bar{x}$ chart.

(e) Define Acceptance Quality Level (AQL) and Lot Tolerance Per cent Defective (LTPD) in the context of a single sampling plan for attributes.

(f) In the context of a single sampling plan for attributes with lot quality p, lot size N and sample size n, derive the expression of Average Amount of Total Inspection (ATI) in terms of the Operating Characteristic (OC) function.

(g) Distinguish between seasonal and cyclical variations in time series data with examples.

(h) For a given data set, describe how the Least Squares Method can be used to fit the exponential curve $u_t = ab^t$.

(i) Describe the method of moving averages for trend determination. How is the period of moving average decided upon?

(j) Define a cost of Living Index Number. How do you compute (a) purchasing power of money and (b) real wages using a cost of Living Index Number?

(k) Define "Crude Death Rate" (CDR) and Specific Death Rate (SDR). Why is SDR preferred over CDR?

(l) If deaths are assumed to be uniformly distributed over the whole year, show that

$$L_x = l_{x+\frac{1}{2}},$$

where the symbols have the usual meaning.

(m) Define Net Reproduction Rate (NRR). What is the significance of NRR = 1?

(n) In the context of a Linear Programming Problem (LPP), define the following:
(a) a feasible solution, (b) a basic feasible solution, (c) an unbounded solution.

(o) Mention in brief the functions of National Sample Survey Organisation.

Group-B

Answer *any five* questions.

2. (a) What is Lorenz Curve in connection with income inequality? Define Gini's measure of concentration (income inequality) and deduce a connection with the area under Lorenz Curve.

(b) What are Specification Limits? (3+3+10)+4=20

3. (a) Define producers' risk and consumer's risk in connection with sampling plan for attributer.

(b) Distinguish between acceptance/rejection sampling plan and acceptance/rectification sampling plan in connection with attribute plans.

(c) For a single sample rectification plan for attributes, if rejected lots are 100% inspected, show that Average Outgoing Quality (AOQ) can be expressed in terms of probability of acceptance (Pa), lot quality (p), lot size (N) and sample size (n). 6+4+10=20

4. (a) Describe a sequential sampling plan for attribute.

(b) Check whether the following index numbers satisfy the Time Reversal Test:

(i) $I_{01} = \frac{\Sigma p_{1i}(q_{0i}\, q_{1i})^{\frac{1}{2}}}{\Sigma p_{0i}(q_{0i}\, q_{1i})^{\frac{1}{2}}}$ (ii) $I_{01} = \frac{\Sigma p_{1i}\, q_{0i}}{\Sigma p_{0i}\, q_{0i}}$ (iii) $I_{01} = \frac{\Sigma p_{1i}\sqrt{q_{0i}}}{\Sigma p_{0i}\sqrt{q_{0i}}}$ 8+(4×3)=20

5. Discuss various problems related to the construction of a Price Index Number. 20

6. (a) Deduce the correlogram of an auto-regressive process of order 1.

(b) Which component of time series is mainly applicable in the following situations?

(i) Fire in a factory

(ii) Decrease in employment in a sugar factory during the off season

(iii) Fall in death rate due to scientific research

Explain the rationale behind your answer in each case. 10+10=20

7. Food *X* contains 6 units of vitamin A and 7 units of vitamin B per gram, and costs Rs. 12·00 per gram. Food *Y* contains 8 units and 12 units of vitamins A and B per gram respectively and costs Rs. 20·00 per gram. The daily requirements of vitamin A and B are at least 100 units and 120 units respectively. Formulate the above as an L.P.P to minimize the cost. Make a graphical representation of the set of constraints and hence find the optimal solution. 10+10=20

8. (a) Show that the following L.P.P has no feasible solution:

Maximize $3x_1 + 5x_2$

Subject to $5x_1 + 5x_2 \leq 25$

$13x_1 + 13x_2 \geq 117,$

$x_1, x_2 \geq 0$

(b) Deduce the following relations:

(i) $q_x = \frac{2m_x}{2+m_x}$ (ii) $\cap p_x = p_x\, p_{x+1} \cdots p_{x+n-1}$

with usual notations. 10+10=20

9. (a) Write a note on estimating National Income.

(b) Describe the role of *CSO*.

(c) Derive the reliability of an n component parallel system, where each component has reliability p.

10+5+5=20

2021

ZOOLOGY

PAPER-II

Time Allowed — 3 Hours *Full Marks — 200*

If the questions attempted are in excess of the prescribed number, only the questions attempted first up to the prescribed number shall be valued and the remaining ones ignored.

Answer may be given either in ***English*** *or in* ***Bengali*** *but all answer must be in one and same language.*

Group-A

1. Answer *any ten* questions. 4×10=40

   (a) Define peptide bond and its significance.

   (b) Mention the components required for DNA replication in a prokaryote system.

   (c) Write notes on GERL.

   (d) Write notes on numerical variation of chromosomes.

   (e) Write notes on multiple allele.

   (f) Describe the open chain form and closed ring form of glucose.

   (g) Add a note on impact of coloration in mimicry.

   (h) Mention the importance of 'Deep litter' system of poultry keeping.

   (i) Explain the methods used for reeling and extraction of silk fibre from cocoon.

   (j) Mention the role of sigma factor and Rho factor in prokaryotic transcription.

   (k) Write short note on Bidirectional DNA replication.

   (l) How polyspermy is prevented?

   (m) Mention the role of Haemoglobin in oxygen transport.

   (n) Write a short note on Cytokines.

   (o) Discuss briefly the pathogenesis of lymphatic filariasis.

   (p) Discuss on IVF.

Group-B

Attempt *any four* questions.

2. Explain the role of the membranous components of Golgi complex in transport of proteins. Describe the ultrastructure of mitochondrial cristae. Explain briefly the 'facilitated diffusion' through plasma membrane. Write the principle of ELISA technique. 5+5+5+5=20

3. Describe Meselson and Stahl experiment to prove replication is semiconservative. State the role of the attenuator in the regulation of tryptophan operon. Write notes on Hairpin termination in transcription. 10+5+5=20

4. (a) Two normal looking Drosophila are crossed and yield the following phenotypes among the progeny.

Females: +++ – 2000

Males:

+++ – 3

abc – 1

+bc – 830

a++ – 835

ab+ – 85

++c – 91

a+c – 80

+b+ – 75

4000

Give parental genotypes, gene arrangement, map distances and the coefficient of coincidence.

(b) "Pseudoalleles are not true alleles but are the members of a complex locus"– explain with suitable examples.

(c) Write notes on TLC. 10+4+6=20

5. (a) Contrast the role of cyclin-dependent kinase (cdk) during the cell cycle.

(b) Elaborate 'one gene one polypeptide concept' in the light of sickle cell anaemia.

(c) Write notes on 'Alternate splicing'.

(d) What is DNA fingerprinting? 6+6+6+2=20

6. (a) Write notes on Sertoli cells and Leydig cells.

(b) How the adrenal cortical cells are stimulated to secrete aldosterone?

(c) State the histology of endocrine pancreas with diagram.

(d) State types of diabetes with their etiology. 5+5+5+5=20

7. (a) State briefly the roles of corpora allata and corpora cardiaca in insect metabolism.

(b) Describe the different steps involved in biosynthesis of thyroxine.

(c) Describe the molecular basis of action of steroid hormone.

(d) What is troponin complex? Discuss the role of Actin in muscle contraction. 5+5+5+5=20

Group-C

Attempt *any four* questions.

8. (a) Explain the phenomenon of induction in development of eye in a vertebrate.
   (b) Write notes on amnion and allantois.
   (c) Discuss the role of primitive streak in gastrulation of chick.
   (d) What is industrial melanism? Explain it taking *Biston betularia* as an example. 5+5+5+5=20

9. (a) Explain Neutral theory.
   (b) Write notes on coacervates.
   (c) Discuss the procedure for the preparation of pituitary extract.
   (d) Briefly discuss the scientific method of apiculture. 5+5+5+5=20

10. (a) Discuss about the components and working principles of ecohatchery for the production of fish seed.
    (b) Mention different steps and limitations of IPM.
    (c) Describe a standard Langstroth's box used in bee keeping. 8+6+6=20

11. (a) Describe the life history of *Wuchereria bancrofti* and discuss the reasons of periodicity of microfilariae in the blood of man.
    (b) Draw and describe T-cell receptor. What do you mean by 'immunological evasion' and 'zoonosis'? 10+(4+6)=20

12. (a) Give a brief idea on the antigen-antibody reaction in human body.
    (b) How is nectar changed into honey? Comment on the chemical composition and economic importance of bee wax.
    (c) Mention the factors responsible for successful induced breeding of fish.
    (d) Give a short account on the biology, nature of damage of jute pest. 5+5+5+5=20

13. (a) Discuss various types of Natural selection as explained in synthetic theory.
    (b) In what way Urey-Miller experiment enriched the chemical basis of origin of life?
    (c) Characterise Shahiwal and Gir breeds of cattle and name their place of availability.
    (d) Illustrate RNA world hypothesis. 6+4+6+4=20
