B.Sc. 4th Semester (Programme) Examination, 2019

PHYSICS

(Physics-IV)

Paper : 401/C-1D

Course ID : 42418

Time: 1 Hour 15 minutes   **Full Marks: 25**

The figures in the right hand side margin indicate marks.

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

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি মান নির্দেশক।

পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

Section-I

1. Answer *any five* questions: 1×5=5

   যে-কোনো পাঁচটি প্রশ্নের উত্তর দাও ঃ

   (a) Distinguish between majority and minority carriers in a semiconductor.

   অর্ধপরিবাহীর ক্ষেত্রে সংখ্যাগুরু এবং সংখ্যালঘু বাহকের মধ্যে পার্থক্য কী?

   (b) What is Hall effect?

   'হল ক্রিয়া' বলতে কী বোঝো?

   (c) What is the effect of reverse bias on the width of a P-N junction?

   P-N সংযোগ ডায়োডে বিপরীতমুখী বায়াসের প্রভাব কী?

   (d) Why is h-parameter model circuit not valid for high frequencies?

   ' h-প্যারামিটার মডেলবর্তনী' উচ্চ কম্পাংকের জন্য প্রযোজ্য নয় কেন?

   (e) What do you mean by CMRR of an OP-AMP?

   OP-AMP-এর CMRR বলতে কী বোঝো?

   (f) Convert $(1001 \cdot 0101)_2$ into its decimal equivalent.

   $(1001 \cdot 0101)_2$ দ্বিক পদ্ধতির এই সংখ্যাটিকে দশমিক পদ্ধতির মানে রূপান্তরিত করো।

   (g) Show how a NAND gate is converted into an OR gate.

   একটি NAND gate-কে কীভাবে OR gate-এ রূপান্তরিত করা হয় দেখাও।

   (h) Draw a neatly labelled circuit diagram of a full wave rectifier.

   একটি পূর্ণতরঙ্গ একমুখীকারকের চিহ্নিত বর্তনী অঙ্কন করো।

Section-II

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

   যে-কোনো দুটি প্রশ্নের উত্তর দাও ঃ

   (a) Explain why a pure silicon semiconductor behaves as an insulator at 0K and its conductivity increases with increasing temperature. Define α and β of a transistor and derive the relationship between them.　　　　　　　2+½+½+2=5

   একটি বিশুদ্ধ সিলিকন অর্ধপরিবাহী 0K উষ্ণতায় কেন অন্তরকের মতো আচরণ করে এবং উষ্ণতা বৃদ্ধি পরিবাহিতাঙ্ক বৃদ্ধি পায় ব্যাখ্যা করো। ট্রানসিস্টারে α এবং β-র সংজ্ঞা দাও এবং এদের সম্পর্ক প্রতিষ্ঠা করো।

   (b) Why CE configuration is most popular in amplifier circuits? Draw a circuit diagram for drawing static characteristics curves of an n-p-n transistor in CE mode. Draw the input and output characteristic curves explaining the nature of the curves.　　　　　　　1+1+3=5

   বিবর্ধক বর্তনী হিসেবে CE মোড বিবর্ধক কেন অধিকতর প্রচলিত? বৈশিষ্ট্য লেখর জন্য CE মোড ট্রানসিস্টারের বর্তনীটি অঙ্কন করো। ইনপুট এবং আউটপুট বৈশিষ্ট্য লেখ অঙ্কন করে চিত্রগুলির বৈশিষ্ট্য ব্যাখ্যা করো।

   (c) Describe the working of a semiconductor diode in forward and reverse biased conditions and draw the volt-ampere characteristics of the same.　　　　　　　3+2=5

   সম্মুখবর্তী এবং বিপরীতমুখী বায়াসে একটি অর্ধপরিবাহী ডায়োডের ক্রিয়া বর্ণনা করো এবং তার ভোল্ট-অ্যাম্পিয়ার বৈশিষ্ট্য লেখটি অঙ্কন করো।

   (d) What is an OP-AMP and why it is called so? Write down the characteristics of an OP-AMP. Explain the concept of virtual ground in an OP-AMP.　　　　　　　1+2+2=5

   OP-AMP কী এবং এইরূপ নামের তাৎপর্য কী? OP-AMP-এর বৈশিষ্ট্যগুলি লেখো। OP-AMP -এর 'অলীক ভূ' (Virtual ground) বলতে কী বোঝো ব্যাখ্যা করো।

Section-III

3. Answer *any one* questions:　　　　　　　　　　　　　　　　　10×1=10

   যে-কোনো একটি প্রশ্নের উত্তর দাও ঃ

   (a) What is a rectifier? Draw a neat circuit diagram of a half wave rectifier and explain its operation. Calculate the efficiency of rectification of this rectifier.　　　　　　　1+5+4=10

   একমুখীকারক বলতে কী বোঝো? একটি অর্ধতরঙ্গ একমুখীকারকের বর্তনীচিত্র অঙ্কন করে তার কার্যপ্রণালী ব্যাখ্যা করো। এই অর্ধতরঙ্গ একমুখীকারকটির দক্ষতার রাশিমালাটি প্রতিষ্ঠা করো।

   (b) State and explain de Mrogan's theorem. Draw the circuit diagram of an OR gate using resistance and diodes. Explain its operation. What is the use of Karnaugh map?　　　3+5+2=10

   ডি মরগ্যানের তত্ত্ব দুটি বিবৃত করে ব্যাখ্যা করো। রোধ এবং ডায়োডের সাহায্যে একটি OR gate-এর কার্যপ্রণালী ব্যাখ্যা করো। কার্নো ম্যাপের ব্যবহার উল্লেখ করো।

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SP-IV/Physics-401/C-1D(PR)/19

B.Sc. 4th Semester (Programme) Practical Examination, 2019
PHYSICS
(Physics IV Lab)
Paper : 401/C-1D
Course ID : 42428

Time: 2 Hours   **Full Marks: 15**

The figures in the margin indicate full marks.

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

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি প্রশ্নের পূর্ণমানের নির্দেশক।

পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

1. Draw I-V characteristics of a suitable resistance and that of a junction diode within specified limit on a graph and hence find d.c. and a.c. resistances of both the elements of the point of intersection.

   লেখচিত্রে নির্দিষ্ট সীমার মধ্যে একটি রোধ এবং একটি সংযোগ ডায়োডের I-V বৈশিষ্ট্য লেখগুলি অঙ্কন করো এবং ছেদবিন্দুতে উভয়ের d.c. এবং a.c. রোধ নির্ণয় করো।

   Distribution of marks:

   Theory:

       Working formula with symbols explained and circuit diagram.   2+2=4

   Systematic recording of data and performance:

       Data recording   5

       Graph   2

   Calculation   1

   Accuracy   1

2. Draw the reverse characteristics of the given Zener diode. Obtain the variation of load voltage with load current for the voltage regulator circuit constructed using the same Zener diode. Hence calculate the percentage regulation.

   বিপরীত বায়াসে প্রদত্ত জেনার ডায়োডের বৈশিষ্ট্যলেখ অঙ্কন করো। একই জেনার ডায়োড ব্যবহার করে নির্মিত ভোল্টেজ নিয়ন্ত্রক বর্তনীর জন্যে লোড-প্রবাহের সঙ্গে লোড-বিভবের পরিবর্তন নির্ণয় করো। এর থেকে শতকরা রেগুলেশনের মান নির্ণয় করো।

Distribution of marks:

Theory:

Working formula with symbols explained and circuit diagrams.   2+(1+1)=4

Systematic recording of data and performance:

Data recording ┬ for reverse characteristics   2

└ for load regulation   3

Graph ┬ reverse characteristics   1½

└ load regulation   1½

Calculation   1

3. Draw output characteristics of a transistor in CE mode for at least 3 different base currents and hence find $\beta_{d.c.}$ and $\beta_{a.c.}$ at any operating point.

সাধারণ নিঃসারক সংযোগ অবস্থায় কার্যরত একটি ট্রানজিস্টারের আউটপুট বৈশিষ্ট্যলেখ কমপক্ষে তিনটি মানের ভূমি প্রবাহের জন্য অঙ্কন করো এবং যে কোনো একটি কার্যকর বিন্দুতে $\beta_{d.c.}$ এবং $\beta_{a.c.}$ নির্ণয় করো।

Distribution of marks:

Theory:

Working formula with symbols explained and circuit diagram.   2+2=4

Systematic recording of data and performance:

Data recording   5

Graph   2

Calculation   1

Accuracy   1

4. Design a CE amplifier with a given midband gain using voltage divider bias and draw the graph showing variation of voltage gain with frequency for the same.

ভোল্টেজ বিভাজক বায়াস দ্বারা নির্মিত এবং প্রদত্ত মধ্যপট্টি বিবর্ধন ক্ষমতাসম্পন্ন একটি সাধারণ নিঃসারক ভোল্টেজ বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তনের লেখটি অঙ্কন করো।

Distribution of marks:

Theory:

Definition of amplifier and circuit diagram.   2+2=4

Systematic recording of data and performance:

Data recording   5

Graph   2

Calculation   1

Accuracy   1

5. Determine the band gap by measuring the resistance of a thermister at different temperatures.

বিভিন্ন তাপমাত্রায় রোধ নির্ণয়ের মাধ্যমে থার্মিস্টারের পটিবেধ নির্ণয় করো।

Distribution of marks:

Theory:

Definition of the quantity to be measured.	1
Working formula with symbols explained.	1
Circuit diagram	2

Systematic recording of data and performance:

Data recording	5
Graph	2
Calculation	1
Accuracy	1

6. Design an inverting amplifier of given gain using OPAMP (741C) and draw the variation of voltage gain with frequency for the same.

OPAMP (741C) ব্যবহার করে প্রদত্ত বিবর্ধন ক্ষমতাসম্পন্ন একটি বিপরীত দশাকারী বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তন দেখাও।

Distribution of marks:

Theory:

Definition of inverting amplifier using OPAMP	2
Circuit diagram	2

Systematic recording of data and performance:

Data recording	6
Graph	3

7. Design a non-inverting amplifier of given gain using OPAMP (741C) and draw the variation of voltage gain with frequency for the same.

OPAMP (741C) ব্যবহার করে প্রদত্ত বিবর্ধন ক্ষমতাসম্পন্ন একটি সম দশাকারী বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তন দেখাও।

Distribution of marks:

Theory:

Definition of non-inverting amplifier using OPAMP	2
Circuit diagram	2

Systematic recording of data and performance:

Data recording	6
Graph	3

8. Construct an adder and a subtractor circuit using full adder IC and verify respective truth-tables.

পূর্ণযোগক IC ব্যবহার করে যোগক এবং বিয়োগক বর্তনী গঠন করো এবং তাদের সংশ্লিষ্ট সত্য-সারণীগুলি প্রতিষ্ঠা করো।

Distribution of marks:

Definition of adder and subtractor	3
Circuit diagram of adder	2
Verification of truth-table of adder	3
Circuit diagram of subtractor	2
Verification of truth-table of subtractor	3

9. Using logic gates simplify the Boolean equations

   (a) $Y = A + \overline{A}B$ and

   (b) $Y = A(\overline{A} + B)$

   construct the circuits and hence compare the truth tables for original and simplified Boolean expressions.

   লজিক গেটসমূহ ব্যবহার করে নিম্নলিখিত বুলীয়ান সমীকরণগুলি সরলীকরণ করো।

   (a) $Y = A + \overline{A}B$ এবং

   (b) $Y = A(\overline{A} + B)$

   প্রতিক্ষেত্রে মূল এবং সরলীকৃত সমীকরণগুলির বর্তনগঠন এবং সত্যসারণীগুলির তুলনা করো।

   Distribution of marks:

Theory	3
Circuit diagram for (1)	2
Verification of truth-table for (1)	3
Circuit diagram for (1)	2
Verification of truth-table for (2)	3

10. Construct NOT, OR, AND and XOR gates from NAND gates and verify respective truth-tables.

    NAND গেট ব্যবহার করে NOT, OR, AND এবং XOR গেট গঠন করো এবং তাদের সংশ্লিষ্ট সত্য-সারণীগুলি প্রতিষ্ঠা করো।

    Distribution of marks:

    Theory:

Definitions of NAND, NOT, OR, AND and XOR gates with respective truth tables.	5

    Systematic recording of data and performance:

Circuit diagram of NOT gate	1
Verification of truth-table of NOT gate	1
Circuit diagram of OR gate	1
Verification of truth-table of OR gate	1
Circuit diagram of AND gate	1
Verification of truth-table of AND gate	1
Circuit diagram of XOR gate	1
Verification of truth-table of XOR gate	1

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B.Sc. 4th Semester (Programme) Examination, 2019

PHYSICS

(Radiation Safety)

Paper : 404/SEC-2

Course ID : 42410

Time: 2 Hours   **Full Marks: 40**

The figures in the margin indicate full marks.

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

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি প্রশ্নের পূর্ণমানের নির্দেশক।

পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

1. Answer *any five* of the following: 2×5=10

যে কোনো পাঁচটি প্রশ্নের উত্তর দাও ঃ

(a) What are sources of α, β and γ rays?

α, β এবং γ রশ্মির উৎস কী?

(b) What are nuclear waste and disposal management?

পারমাণবিক বর্জ্য এবং নিষ্পত্তি ব্যবস্থাপনা কী?

(c) What do you mean by 'bremsstrahlung' radiation?

'bremsstrahlung' বিকিরণ বলতে কী বোঝো?

(d) State the law of radiation decay. Define 1 curie.

তেজস্ক্রিয় বিঘটনের সূত্রটি বিবৃত করো। 1 curie-র সংজ্ঞা দাও।

(e) What is biological effects of ionizing radiation?

ionizing বিকিরণের জৈবিক প্রভাব কী?

(f) A radioactive sample has its half-life equal to 60 days. Calculate its (i) disintegration constant and (ii) Mean life.

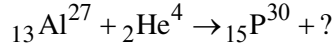একটি তেজস্ক্রিয় নমুনার অর্ধায়ু 60 দিন। ওই নমুনার (i) বিঘটন ধ্রুবক এবং (ii) গড় আয়ু নির্ণয় করো।

(g) Write down the 'Bethe-Bloch' formulae.

'Bethe-Bloch' সূত্রটি লেখো।

(h) What do you mean by 'recovering time' in respect of a G.M. counter? Complete the nuclear equation:

$$_{13}Al^{27} + _2He^4 \rightarrow _{15}P^{30} + ?$$
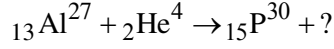
G.M. counter-এ পুনরুদ্ধারের সময় বলতে কী বোঝো? নিউক্লীয় সমীকরণটি সম্পূর্ণ করো ঃ

$$_{13}Al^{27} + _2He^4 \rightarrow _{15}P^{30} + ?$$

2. Answer *any four* of the following: 5×4=20

যে কোনো চারটি প্রশ্নের উত্তর দাও ঃ

(a) What do you understand by 'mass defect' and binding energy of a nucleus? Draw a curve showing the variation of binding energy per nucleon against the mass number. 2+2+1=5

নিউক্লিয়াসের ভরত্রুটি ও বন্ধনশক্তি বলতে কী বোঝো? একটি নিউক্লীয় প্রতি বন্ধন শক্তির সাথে ভরসংখ্যার লেখচিত্র অঙ্কন করো।

(b) What is meant by 'half-life' of radioactive substance? Establish the relation between 'half-life' and 'mean life'. 1+4=5

তেজস্ক্রিয় পদার্থের 'অর্ধায়ু' বলতে কী বোঝো? তেজস্ক্রিয় পদার্থের 'গড় আয়ু' ও 'অর্ধায়ু'র মধ্যে সম্পর্ক প্রতিষ্ঠা করো।

(c) Write down the five application of nuclear techniques. 5

পারমাণবিক প্রযুক্তির পাঁচটি প্রয়োগ উল্লেখ করো।

(d) Mention the three main properties of nuclear radiation used in the detection instruments. Write down the working principle of gas detectors. 3+2=5

শনাক্তকরণ যন্ত্রে ব্যবহৃত পারমাণবিক বিকিরণের তিনটি প্রধান বৈশিষ্ট্য উল্লেখ করো। গ্যাস ডিটেক্টরের কার্যনীতিটি লেখো।

(e) What is pair production? Explain. A free electron dacays into a proton, an electron and an antineutrino if $M(n) = 1\cdot00898u$, $M(p) = 1\cdot00759u$ and $M(e) = 0\cdot00055u$, find the kinetic energy shared by the electron and the antineutrino. 2+3=5

জোড়া উৎপাদন কী? ব্যাখ্যা করো। একটি মুক্ত নিউট্রন বিঘটনের ফলে একটি প্রোটন, একটি ইলেকট্রন এবং একটি অ্যান্টি-নিউট্রিনো উৎপন্ন হয়েছে। যদি $M(n)$ = 1·00898u, $M(p)$ = 1·00759u এবং $M(e)$ = 0·00055u ইলেকট্রন এবং অ্যান্টি-নিউট্রিনো দ্বারা ভাগ করা মোট গতিশক্তি নির্ণয় করো।

(f) Write down the ICRP principles of radiation protection.

বিকিরণের সুরক্ষা সম্পর্কে ICRP-এর নীতিগুলি লেখো।

3. Answer *any one* question: 10×1=10

যে কোনো একটি প্রশ্নের উত্তর দাও ঃ

(a) What is nuclear fusion? Explain how much temperature is required for nuclear fusion. State whether it is a controlled process or not. Explain the source of energy coming from the Sun. Calculate the energy released in the reaction $_3\text{Li}^6 + _0\text{n}^1 \rightarrow _2\text{He}^4 + _1\text{H}^3$.

Given : $M(_3\text{Li}^6) = 6 \cdot 015123u, M(_1\text{H}^3) = 3 \cdot 016029u$,

$M(_0\text{n}^1) = 1 \cdot 008665u, M(_2\text{He}^4) = 4 \cdot 002603u$ (1+2)+(1+1)+2+3=10

নিউক্লীয় সংযোজন কী? ব্যাখ্যা করো। নিউক্লীয় সংযোজনের জন্য কেমন উষ্ণতার প্রয়োজন? এই প্রক্রিয়াটি নিয়ন্ত্রিত না অনিয়ন্ত্রিত? সূর্য থেকে যে শক্তি আসে তার উৎস ব্যাখ্যা করো।

$_3\text{Li}^6 + _0\text{n}^1 \rightarrow _2\text{He}^4 + _1\text{H}^3$ বিক্রিয়াটিতে নির্গত শক্তির মান কত?

প্রদত্ত ঃ $M(_3\text{Li}^6) = 6 \cdot 015123u, M(_1\text{H}^3) = 3 \cdot 016029u$,

$M(_0\text{n}^1) = 1 \cdot 008665u, M(_2\text{He}^4) = 4 \cdot 002603u$

(b) Describe a G.M. counter and explain its principle of operation with counting system. What is meant by the 'dead time' of a G.M. counter? What do you mean by range of an α particle? 4+3+1+2=10

গাইগার মূলার (G.M.) গণনের বিবরণ দাও ও কার্যনীতি ব্যাখ্যা করো। ওই গণনের ক্ষেত্রে 'ডেড সময়' বলতে কী বোঝো? α কণার পাল্লা বলতে কী বোঝো?

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B.Sc. 4th Semester (Programme) Practical Examination, 2019

PHYSICS

(Physics IV Lab)

Paper : 401/C-1D

Course ID : 42428

Instructions to the Examiners.

The examiners are requested to paste one question on a card with respective serial number of the question. Cards may be duplicated, but the total number of cards may exceed the number of examinees. A list of arranged experiment sets signed by both the examiners along with answer script packet should be sent to The University. In no case, Examination will be conducted by the Examiner alone. Secrecy of the result must be maintained.

Each candidate should perform the experiment which is noted on the card drawn by him/her. The examiners may, however, use their discretion in offering him/her a second chance only after drawing card by all the candidates. The Laboratory Notebook must be submitted by the candidates before drawing of the card. **No credit should be given to Notebook which has not been signed**.

Candidates are required to write down the questions on one answer-script with respective number of the questions and return the card to the examiner. Candidates will first write down the theory (only for working formula explaining the symbol used) in presence of examiners and get them signed by either of the examiners.

Examiners are requested to see that the candidates are working according to instruction and to sign some important data for the experiment. Each answer script should be examined jointly by the Internal and External and should bear the signature of both examiners. All changes must be initiated by both the examiners. Marks for each item theory, data recording, graph, calculation and accuracy of result must be shown separately. Total marks for experiment should also be shown on the back side of the cover page.

Marks distribution :

Laboratory Notebook —   2

Experiment —   13

If the candidate is found unable to write working formula, it may be supplied by the examiners but no mark on that head will be awarded. Proper handling of the instruments, setting of the apparatus and systematic recording of data should be taken into account while allotting marks for systematic recording of data.

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B.Sc. 4th Semester (Honours) Examination, 2019

PHYSICS

(Mathematical Physics-III)

Paper : 401/C-8/T-8

Course ID : 42411

Time: 1 Hour 15 Minutes **Full Marks: 25**

The figures in the right hand side margin indicate marks.

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

Section-I

1. Answer *any five* questions: 1×5=5

   (a) Show that the vectors $\alpha_1 = \begin{pmatrix} 2 \\ 1 \\ 1 \end{pmatrix}, \beta = \begin{pmatrix} -2 \\ 1 \\ 2 \end{pmatrix}, \gamma = \begin{pmatrix} 0 \\ 0 \\ 1 \end{pmatrix}$ are linearly independent.

   (b) What do you mean by Isomorphism of two vector spaces?

   (c) What is Calay-Hamilton's theorem for a non-singular matrix?

   (d) Let $u = (3, -2, 1)$ and $v = (1, 2, 1)$ be two vectors. Find a vector w such that u, v, w are mutually orthogonal.

   (e) Find the Fourier transform of $f(x) = \begin{cases} 1 \text{ for } |x| < 1 \\ 0 \text{ for } |x| > 1 \end{cases}$.

   (f) Find $L^{-1}\left(\frac{3}{2S+9}\right)$.

   (g) State Fourier Integral theorem.

   (h) What do you mean by matrix diagonalization?

Section-II

Answer *any two* questions. 5×2=10

2. (a) What do you mean by basis and dimension of a vector space $V(F)$ over the scalar field F?

   (b) What is linear transformation or linear mapping in vector space?

   (c) Consider a transformation T on the certain plane R^2 when $T(x, y) = (y, x)$. Verify that this mapping or transformation is linear transformation. 1+2+2=5

3. (a) Find the inverse cosine transform of e^{-5x}.

   (b) Find the Fourier sine transform of $\frac{1}{x}$. 3+2=5

4. Using Laplace transform solve the following differential equation : 5

$$\frac{dx}{dt} + x + y = 0$$

$$\frac{dy}{dt} + 4x + y = 0, \text{given } x(0) = y(0) = 1$$

5. (a) Express $f(x) = \begin{cases} 1 \text{ for } 0 \le x \le \pi \\ 0 \text{ for } x > \pi \end{cases}$ as a Fourier sine Integral and hence evaluate

$$\int_0^\infty \frac{1-\cos \pi\lambda}{\lambda} \sin \lambda x \, dx.$$

(b) For a given function $f(x)$, show that Laplace transform of 2nd order derivative of $f(x)$ is given by $L[f''(x)] = S^2 F(s) - sf(0) - f'(0)$ where $F(s) = L[f(x)]$. (2+1)+2=5

Section-III

Answer *any one* question. 10×1=10

6. (a) Solve the following heat conduction equation by using Fourier sine transform. The equation is $\frac{\partial u}{\partial t} = k\frac{\partial^2 u}{\partial x^2}$ under the condition (i) $u(0, t) = 0$

(ii) $u(x, 0) = e^{-x}$

(iii) $u(x, t)$ is bounded .

(b) Construct using the Gram-Schmidt process, an orthogonal basis of $V_3(R)$, given a basis $X_1 = [1, 1, 1]', X_2 = [1, -2, 1]', X_3 = [1, 2, 3]'.$

(c) Verify Caley-Hamiltonian theorem for the matrix $A = \begin{pmatrix} 1 & 2 \\ 2 & -1 \end{pmatrix}.$ 5+3+2=10

7. (a) Damped harmonic oscillator equation is given by $m\frac{d^2\Psi(t)}{dt^2} + \gamma\frac{d\Psi(t)}{dt} + k\,\Psi(t) = 0$. Symbols have their usual meaning. Find $\Psi(t)$ for small damping by using Laplace transform.

(b) Show that Fourier transform of $f(x) = \begin{cases} a - |x| \text{ for } |x| < a \\ 0 \quad\quad \text{ for } |x| > a > 0 \end{cases}$ is $\sqrt{\frac{2}{\pi}}\left(\frac{1-\cos as}{s^2}\right).$ 5+5=10

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Mathematical Physics Lab-III)

Paper : 401/C-8/(P-8)

Course ID : 42421

Time: 2 Hours   **Full Marks: 15**

The figures in the right hand side margin indicate full marks.

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

Perform any two *programs taking* one *from each group.*

SET-I

Group-A   5×1=5

1. Write a program to solve the differential equation $\frac{dy}{dx} = e^{-x}$ with boundary condition $y = 0$ at $x = 0$. Find the value of $y(x)$ for $x = 10$.

2. Write a program to determine the sum $\sum_{n=1}^{\infty}(0{\cdot}2)^n$.

3. Write a program to find the square roots of the complex number $-5 + 12j$.

Group-B   8×1=8

4. Write a program to solve the differential equation $\frac{d^2y}{dt^2} + e^{-t}\frac{dy}{dt} = -y$ with boundary condition $y = 0$ at $t = 0$ and $\frac{dy}{dt} = -10$ at $t = 0$. Plot the function (*i.e. y*) from $t = 0$ to $t = 10$.

5. Write a program to find the coefficients of a Fourier expansion of square wave function.

6. Plot the least square fit curve for the given set of values:

x	1.0	1.5	2.0	2.5	3.0	3.5
y	0.3	0.5	0.8	1.0	1.1	1.3

Evaluate standard deviation of fitting.

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Mathematical Physics Lab-III)

Paper : 401/C-8/(P-8)

Course ID : 42421

Time: 2 Hours　　　　　　　　　　　　　　　　　　　　　**Full Marks: 15**

The figures in the right hand side margin indicate full marks.

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

Perform any two *programs taking* one *from each group.*

SET-II

Group-A　　　　　　　　　　　　　　　　　　　　　　5×1=5

1. Write a program to solve the differential equation $\frac{dy}{dt} = 4y$ with boundary condition $y = 1$ at $t = 0$. Find the value of y at $t = 1$.

2. Write a program to determine the sum $\sum_{n=1}^{\infty}(0\cdot1)^n$.

3. Write a program to find the square roots of the complex number $3 + 4i$.

Group-B　　　　　　　　　　　　　　　　　　　　　　8×1=8

4. Write a program to solve the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + y = 0$ with boundary condition $y(2) = 3$ and $y'(4) = -2$. Find the values of y and y' for $t = 5$.

5. Write a program to determine Fourier coefficients (first 5) of the function $f(x) = x$.

6. From the following data points make a graph. Using least square linear fitting, make a fitting curve. Evaluate standard deviation of the fitting.

Weight	0.0	0.2	0.4	0.6	0.8	1.0	1.2
Displacement	5.05	5.10	5.20	5.22	5.24	5.26	5.27

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Mathematical Physics Lab-III)

Paper : 401/C-8/(P-8)

Course ID : 42421

Time: 2 Hours   **Full Marks: 15**

The figures in the right hand side margin indicate full marks.

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

Perform any two programs taking one from each group.

SET-III

Group-A   5×1=5

1. Write a program to solve differential equation $\frac{dy}{dx} = x^2 - e^{-x} \cdot y$ with boundary condition $y = 0$ at $x = 0$. Get the solution for $x = 50$.

2. Write a program to determine the cube roots of unity.

3. Write a program to find the square roots of a complex number $0 + 2i$.

Group-B   8×1=8

4. Write a program to solve the differential equation $\frac{d^2y}{dx^2} - 3\frac{dy}{dx} + 2y = 0$ with boundary condition $y(0) = 0$ and $y'(0) = 0$. Determine the value for y and $\frac{dy}{dx}$ at $x = 1$.

5. Write a program to determine Fourier coefficients (first 5) of the function $f(x) = x^2$.

6. From the following data points make a graph. Using least square linear fitting, make a fitting curve. Evaluate the standard deviation of the fitting.

x	1.00	1.25	1.50	1.75	2.00	2.25	2.50
y	0.3	0.4	0.5	0.6	0.8	0.9	1.0

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Mathematical Physics Lab-III)

Paper : 401/C-8/(P-8)

Course ID : 42421

Time: 2 Hours   **Full Marks: 15**

The figures in the right hand side margin indicate full marks.

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

Perform any two *programs taking* one *from each group.*

SET-IV

Group-A   5×1=5

1. Write a program to solve differential equation $2xy\frac{dy}{dx} = x^2 + y^2$ with boundary condition $y = 0$ at $x = 1$. Determine the value of the function (y) at $x = 2$.

2. Write a program to determine the fifth root of unity.

3. Write a program to evaluate the sum $\sum_{n=1}^{\infty}(0.3)^n$.

Group-B   8×1=8

4. Write a program to solve the differential equation $\frac{d^2y}{dt^2} + \frac{dy}{dt} + y = 0$ with $y(1) = 1$ and $y'(2) = -3$. Find the values of y and y' at $t = 1.5$.

5. Write a program to determine Fourier coefficients (first 5) of the function $f(x) = x^3$.

6. From the following data points make a graph. Using least square linear fitting, make a fitting curve. Evaluate standard deviation of the fitting.

Weight	0.0	0.1	0.2	0.3	0.4	0.5
Displacement	5.05	5.07	5.10	5.15	5.20	5.22

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Mathematical Physics Lab-III)

Paper : 401/C-8/(P-8)

Course ID : 42421

Instruction To The Examiners

Examiners are requested to provide either Linux or Windows operating system. Scilab 6.0.1 (or higher) version should be used to perform the practical. Examiners are requested to confirm the matter that **operating system should not be a barrier** for the students.

The signed Computer Notebook (CNB) must be submitted by a candidate before taking the answer script and question. **No candidate is allowed to perform program without signed CNB**. Students have to perform two questions taking one question from each group. After writing the programs in answer script, the students are allowed to use computer. Examiners are requested to put down their signature in answer script mentioning if the program runs successfully or not. Candidates should take a print out of the output if the program consist a graph.

Marks distributions are as follows:

Computer Notebook (CNB)   :   2

Marks for Group 'A' question   :   5

Marks for group 'B' question   :   8

Full credit will be given if the program runs successfully. Examiners are requested to give credit of maximum 2 marks for Group A and 3 marks for Group B, for writing the program correctly in the answer-script. Examiners are requested to open the question paper in the following schedule:

Set-I—Day I First Half

Set-II—Day I Second Half

Set-III—Day II First Half

Set-IV—Day II Second Half

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B.Sc. 4th Semester (Honours) Examination, 2019
PHYSICS
(Elements of Modern Physics)
Paper : 402/C-9
Course ID : 42412

Time: 1 Hour 15 minutes   **Full Marks: 25**

The figures in the right hand side margin indicate full marks.

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

1. Answer *any five* questions: 1×5=5

   (a) State Heisenberg's uncertainty principle.

   (b) What do you mean by eigenfunction?

   (c) Why is Compton scattering considered as an incoherent scattering?

   (d) What are the different modes of β decay?

   (e) What do you mean by magic numbers?

   (f) What is the relation between nuclear size and mass number?

   (g) State the law of radioactive decay.

   (h) What do you mean by metastable state connected with laser?

<p align="center">Answer any two questions.   5×2=10</p>

2. What do you mean by threshold frequency in photoelectric effect? How can the Planck's constant '*h*' be estimated using Einstein's photoelectric equation?   1+4=5

3. What is the stationary state of a wave function? Which among the following wave functions are acceptable in quantum mechanics? Explain your answers.   1+4=5

   (a) $\psi(x) = \sin x$

   (b) $\psi(x) = \tan x$

   (c) $\psi(x) = \frac{1}{x^2 - a^2}$

   (d) $\psi(x) = e^{\frac{1}{x}}$

4. (a) Calculate the de-Broglie wavelength of an electron moving with velocity $\frac{3}{5}c$, where c is the velocity of light in free space.

   (b) Show that free electrons cannot exist within the nucleus.   2+3=5

5. (a) Write down the properties of a laser beam.

   (b) What is population inversion?

   (c) Write down the different ways to achieve population inversion.   2+1+2=5

Answer *any one* question.   10×1=10

6. (a) Calculate the energy eigenvalues and normalized wave function for a particle of mass m confined in a one dimensional infinite potential well of dimension L.

   (b) Draw the wave function for $n = 1$ and $n = 2$ energy level.   (4+4)+2=10

7. (a) What are the basic similarities between a liquid drop and an atomic nucleus?

   (b) Obtain an expression for the binding energy of a nucleus in the ground state on the basis of semi emperical mass formula of Weizsäcker.

   (c) What are the ground state angular momenta of the following nuclei as predicted by the shell model $_6C^{13}$ and $_8O^{17}$.   2+6+2=10

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Modern Physics Lab)

Paper : 402/C-9

Course ID : 42422

Time: 2 Hours   **Full Marks: 15**

The figures in the right hand side margin indicate full marks.

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

The questions are of equal value.

1. Study the variation of photo current due to emitted electrons from cathode of a photo-electric effect apparatus with (i) intensity and (ii) wavelength of incident radiation.

   Distribution of marks:

   Definition of the quantity to be measured : 1

   Theory (working formula with explanation of symbols) : 2

   Systematic recording of data:

   (i) Data for photo current vs. intensity : 3½

   (ii) Data for photo current vs. wavelength : 3½

   Graph : 2

   Accuracy : 1

2. Using photo electric effect apparatus study the variation of maximum energy of photoelectrons with the frequency of incident radiation. Draw a graph and determine the threshold frequency from the graph.

   Distribution of marks:

   Definition of the quantity to be measured : 1

   Theory (working formula with explanation of symbols) : 2

   Recording of stopping potential vs. frequency : data for 4 frequencies : 6

   Graph : 2; Calculation : 1; Accuracy : 1.

3. Determine the wavelength of H_α emission line of Balmer series of H-atom using spectrometer and plane diffraction grating. [No. of rulling for grating to be supplied]

Distribution of marks:

Theory (working formula with explanation of symbols) : 1

Adjustment of the spectrometer : 1

Vesinier constant of the spectrometer : 1

Adjustment of grating for normal incidence : 2

Data for angle of diffraction with three orders : 6

Calculation : 1; Accuracy : 1

4. Determine the work function of the material of filament of a directly heated vacuum diode. Record the diode currents and temperatures of filament. Plot a graph between

In $\left(I/_{T^2}\right)$ vs. $\frac{1}{T}$ [I : diode current, T : Temp.].

Distribution of marks:

Definition of the quantity to be measured : 1

Theory (working formula with explanation of symbols) : 2

Recording of data : 6

Graph : 2; Calculation : 1; Accuracy: 1.

5. Determine the ratio $e/_m$ by using CRT [cathode ray tube] and a pair of bar magnets [Thompson Apparatus]. Take at least three values of displacements of spot on CRT and for both direct and reverse Y-plate voltages. [Values of B_h and all CRT constants are to be supplied]

Distribution of marks:

Definition of the quantities to be measured : 1

Theory (working formulas with explanation of symbols) : 2

Recording of data : 7

Calculation : 2; Accuracy: 1.

6. Determine the charge of electron using Millikan's oil drop apparatus. Take at least 5 sets of applied voltage along vertical plates.

[Values of η, σ, ρ distance between plates (d) are to be supplied.]

Distribution of marks:

Definition of the quantity to be measured : 1

Theory (working formula with explanation of symbols) : 2

Recording of data : 7; Calculation : 2; Accuracy: 1.

7. Determine the wavelength of a Laser source using diffraction pattern in a single slit. Take three different distances between slit and screen. [The slit width is to be supplied.]

   Distribution of marks:

   Definition of the quantity to be measured : 1

   Theory (working formula with explanation of symbols) : 2

   Recording of data : 7; Calculation : 2; Accuracy: 1.

8. Determine the wavelength of Laser source using double slit diffraction pattern.

   Distribution of marks:

   Definition of the quantity to be measured : 1

   Theory (working formula with explanation of symbols) : 1

   Recording of data for (i) linear distance between two successive dark band : 5 (ii) Slit width and separation between slit using microscope : 3

   Calculation : 2; Accuracy: 1.

9. Draw the forward bias I-V characteristic of an ordinary PN diode and hence determine the value of Boltzmann constant from the graph.

   Distribution of marks:

   Definition of the quantity to be measured : 1

   Theory (working formula with explanation of symbols) : 2

   Recording of data : 5

   Graph : 2; Calculation : 2; Accuracy: 1.

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Modern Physics Lab)

Paper : 402/C-9/P-9

Course ID : 42422

INSTRUCTION TO THE EXAMINERS

The examiners are requested to paste one question on a card with respective serial number of the question. Cards may be duplicated, but the total number of cards may exceed the number of examinees. A list of arranged experiment sets signed by both the examiners along with answer script packet should be sent to The University. In no case, Examination will be conducted by the Examiner alone. Secrecy of the result must be maintained.

Each candidate should perform the experiment which is noted on the card drawn by him/her. The examiners may, however, use their discretion in offering him/her a second chance only after drawing card by all the candidates. The Laboratory NoteBook must be submitted by the candidates before drawing of the card. **No credit should be given to NoteBook which has not been signed.**

Candidates are required to write down the questions on one answer-script with respective number of the questions and return the card to the examiner. Candidates will first write down the theory (only for working formula explaining the symbol used) in presence of examiners and get them signed by either of the examiners.

Examiners are requested to see that the candidates are working according to instruction and to sign some important data for the experiment. Each answer-script should be examined jointly by the Internal and External Examiner and should bear the signature of both examiners. All changes must be initiated by both the examiners. Marks for each item theory, adjustment of apparatus, data recording, graph, calculation and accuracy of result must be shown separately. Total marks for experiment should also be shown on the back side of the cover page.

Marks distribution:

Laboratory Notebook—2

Experiment—13

If the candidate is found unable to write working formula, it may be supplied by the examiners but no mark on that head will be awarded. Proper handling of the instruments, setting of the apparatus and systematic recording of data should be taken into account while allotting marks for systematic recording of data.

Special instructions for different experiments:

Experiment No. 3 : (i) Examiners are requested to check whether the candidate is done proper levelling of spectrometer or not. (ii) Setting of grating perpendicular to collimator is an important part of the experiment and must be checked by the examiners. (iii) Value of number of rules per unit length of the given grating is to be supplied.

Experiment No. 4: The filament temperature can be determined directly by thermometer or using calibration curve. But it is preferable to use thermometer. Examiners are requested to provide apparatus in which temperature can be measured using thermometer (if possible).

Experiment No. 5: Supplied data — (i) Horizontal component of earth's magnetic field B_h (ii) Constants of the CRT like vertical distance between two deflecting plate, length of the Y-deflecting plate, distance from the centre of Y-plate to the CRT screen etc.

Experiment No. 6: Supplied data — density of the given liquid (σ), density of the medium (ρ), coefficient of viscosity of the medium (η), distance between two plates (d) etc.

Experiment No. 9: Supplied data — width of the single slit.

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B.Sc. 4th Semester (Honours) Examination, 2019

PHYSICS

(Analog Systems and Applications)

Paper : 403/C-10

Course ID : 41413

Time: 1 Hour 15 Minutes   Full Marks: 25

The figures in the margin indicate full marks.

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

Section I

1. Answer *any five* questions: 1×5=5

   (a) Explain why a semiconductor behaves like an insulator at 0K.

   (b) An n-channel JFET has I_{DSS} = 12 mA. If the pinch off voltage V_P = –4V, find the drain current for V_{GS} = –2V.

   (c) Define CMRR of an Op-amp.

   (d) Schematically show the energy band diagram of a forward biased p-n junction.

   (e) What is 'dark current' in case of a photodiode ?

   (f) The power gain of an amplifiers is 30 dB. If the input power is 1 mW, calculate the output power.

   (g) Define transistor 'α' and 'β' and write a relation between them.

   (h) Why is stabilization of operating point of a transistor needed?

Section II

2. Answer *any two* questions: 5×2=10

   (a) With a neat circuit diagram explain the operation of a full wave rectifier circuit.

   (b) Derive an expression for rectification efficiency of full wave rectifier circuit.   3+2=5

3. Show that negative feedback stabilizes the gain of an amplifier. Derive the expression of frequency of oscillation of a Hartley Oscillator.   2+3=5

4. (a) Draw the basic structure of an n-channel enhancement type MOSFET with labelling.

   (b) Explain the operation and graphically represent the drain characteristics of n-channel enhancement type MOSFET.   2+3=5

5. The operating point of the voltage divider circuit (fig below) is chosen such that I_C = 2 mA, V_{CE} = 3 V. If R_C = 2·2 kΩ, V_{CC} = 9 V and β = 50. Determine the value of R_1, R_2 and R_E. Given V_{BE} = 0·3 V and I_1 = 10 I_B.   1+2+2=5
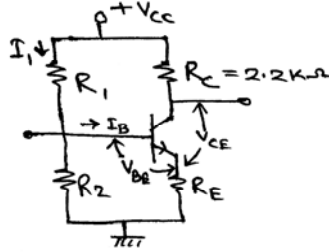
Section III

6. Answer *any one* question: 10×1=10

   (a) Obtain the h-parameter ac equivalent circuit of a CE mode BJT without emitter resistor. Apply this model to find the voltage gain and input resistance.

   (b) Obtain an expression for mid frequency gain of a single stage R-C coupled transistor amplifier.   2+2+2+4=10

7.   (a) Write the characteristics of an Ideal Op-amp. What do you mean by virtual ground?

   (b) Draw a circuit diagram of a non-inverting voltage amplifier using Op-amp and find the voltage gain of the circuit in terms of circuit parameters.

   (c) Explain how an Op-amp may be used as differentiator.

   (d) Draw the output of the following circuit: (1+2)+3+3+1=10
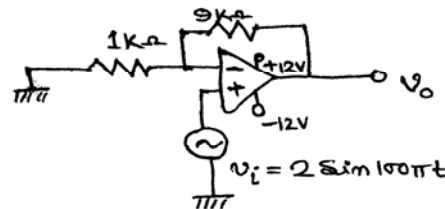
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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Analog System and Application Lab)

Paper : 403/C-10

Course ID : 42423

Time: 2 Hours   **Full Marks: 13+2 (LNB)=15**

The figures in the right hand side margin indicate full marks.

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

1. Draw the input characteristics curves of the given transistor in the CE mode and hence determine a.c. input resistance.[At least three curves to be drawn.]

    (a) Definition   1

    (b) Working formula with explanation of symbols   1

    (c) Circuit diagram and circuit connections   1+1

    (d) Data recording   5

    (e) Graph   3

    (f) Calculation of input resistance   1

2. Draw the output characteristics curves of the given transistor in the CE mode and hence determine d.c. and a.c. current gains. [Curves should be drawn for saturation and active region. At least three curves to be drawn.]

    (a) Definition   1

    (b) Working formula with explanation of symbols   1

    (c) Circuit diagram and circuit connections   1+1

    (d) Data recording   5

    (e) Graph   2

    (f) Calculation of α and β 1+1

3. To design a 4 bit digital to analog converter using R-2R ladder network and operational amplifier on a bread board.

    (a) Working formula with explanation of symbols   2

    (b) Circuit diagram   2

    (c) Data recording   6

    (d) Verification   2

    (e) Accuracy   1

4. To design inverting amplifier using OP-Amp (741, 351) for DC voltages. [Take at least six input voltage with two R_f].

    (a) Definition   1

    (b) Working formula with explanation of symbols   1

    (c) Circuit diagram and connections   1+1

    (d) Offset Null adjustment   1

    (e) Recording of data   5

    (f) Graph   2

    (g) Comparison with theoretical value   1

5. To design non-inverting amplifier using OP-Amp (1C741) for DC voltage. [Take at least six input voltage with two R_f].

    (a) Definition   1

    (b) Working formula with explanation of symbols   1

    (c) Circuit diagram and connections   1+1

    (d) Null adjustment   1

    (e) Recording of data   5

    (f) Graph   2

    (g) Comparison with theoretical value   1

6. Using an Op-Amp set up a three inputs weighted adder circuit. Find the output voltage and verify the result. [Take at least two R_f (Feedback Revision).]

    (a) Definition   1

    (b) Working formula   1

    (c) Circuit diagram & connections   1+1

    (d) Null adjustment   1

    (e) Recording   5

    (f) Verification   2

    (g) Accuracy   1

7. Study the response of a zero crossing detector for a sinusoidal signal of frequency 1kHz and 4 volt peak to peak amplitude.

    (a) Definition of the quantity to be measured   1

    (b) Circuit diagram and connections   1+2

    (c) Draw the output wave form for both zero crossing detector in inverting and non-inverting mode using CRO   3+3

    (d) Determine the frequency of the output waveform from CRO   2

    (e) Accuracy   1

8. Study the frequency response of a CE transistor amplifier with voltage divider bias. Find the mid frequency gain of the circuit.

   (a) Definition of the quantity to be measured   1

   (b) Circuit diagram   2

   (c) Design of voltage divider CE amplifier circuit (values of $R_E, C_E, R_1, R_2, C_i, C_o, R_c$ should be supplied)   2

   (d) Recording of data   5

   (e) Plotting of frequency vs. gain graph   2

   (f) Calculation   1

9. Investigate the use of an operation v amplifier as differentiator using triangular wave of frequency 1 kHz.

   (a) Working formula with circuit diagram   3

   (b) Construction of the circuit (Recommended $R = 1$ kΩ, $c = 0.1$ μF)   2

   (c) Drawing of input and output waveform   2

   (d) Recording of input voltage amplitude, output voltage amplitude and frequency from CR_o
         2+2+2

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Analog System and Application)

Paper : 403/C-10

Course ID : 42423

Instruction To The Examiners

The Examiners are requested to paste one question on a card with respective serial number of the question. Cards may be duplicated, but the total number of cards may exceed the number of examinees. A list of arranged experiment sets signed by both the examiners along with answer-script packet should be sent to the University. In no case, Examination will be conducted by the Examiner alone. Secrecy of the result must be maintained.

Each candidate should perform the experiment which is noted on the card drawn by him/her. The examiners may, however, use their discretion in offering him/her a second chance only after drawing card by all candidates. The Laboratory Notebook must be submitted by the candidates before drawing of the card. **No credit should be given to Notebook which has not been signed.**

Candidates are required to write down the questions on one answer-script with respective number of the questions and return the card to the examiner. Candidates will first write down the theory (only for working formula explaining the symbol used) in presence of examiners and get them signed by either of the examiners.

Examiners are requested to see that the candidates are working according to instruction and to sign some important data for the experiment. Each answer-script should be examined jointly by the Internal and External Examiner and should bear the signature of both examiners. All changes must be initiated by both the examiners. Marks for each item theory, adjustment of apparatus, data recording, graph, calculation and accuracy of result must be shown separately. Total marks for experiment should also be shown on the back side of the cover page.

Marks distribution:

Laboratory Notebook—2

Experiment—13

If the candidate is found unable to write working formula, it may be supplied by the examiners but no mark on that head will be awarded. Proper handling of the instruments setting of the apparatus and systematic recording of data should be taken into account while allotting marks for systematic recording of data. Marks for accuracy are to be awarded on the basis of the correct result, calculated by the examiners.

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B.Sc. 4th Semester (Honours) Examination, 2019

PHYSICS

(Electronics and Instrumentation)

Paper : 404/GE-4

Course ID : 42414

Time: 1 Hour 15 Minutes   **Full Marks: 25**

The figures in the margin indicate full marks.

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

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি প্রশ্নের পূর্ণমানের নির্দেশক।

পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

Section-1

Answer *any five* questions.   1×5=5

যে কোনো পাঁচটি প্রশ্নের উত্তর দাও।

1. How are α and β of a transistor related?

   একটি ট্রানসিস্টারে α এবং β-র মধ্যে সম্পর্ক কী?

2. Write down the binary equivalent of $(0.625)_{10}$.

   $(0.625)_{10}$ সংখ্যাটির দ্বিক্ পদ্ধতিতে মান কত?

3. What is LED? Give one of its use.

   LED কী? এর একটি ব্যবহার উল্লেখ করো।

4. What is zener breakdown?

   'জেনার ব্রেকডাউন' বলতে কী বোঝো?

5. What is 2's compliment of the number (1100)?

   $(1100)_2$ সংখ্যার 2's compliment রূপটি লেখো।

6. Give example of direct and indirect band semiconductor.

   Direct এবং Indirect Band অর্ধপরিবাহীর উদাহরণ দাও।

7. State de Morgan's theorem.

   de Morgan-এর তত্ত্বগুলি লেখো।

8. Why is *h* parameter model circuit not valid for high frequencies?

   '*h* parameter model' বর্তনী উচ্চ-কম্পাঙ্কে প্রযোজ্য নয় কেন?

Section-2

Answer *any two* questions. 5×2=10

যে কোনো *দুটি* প্রশ্নের উত্তর দাও।

1. What is zener diode? Explain how it stabilizes voltage across a load resistance. 1+4=5

   জেনার ডায়োড কী? এটি কীভাবে কোনো ভার রোধের প্রান্তীয় ভোল্টেজকে সুস্থিত করে ব্যাখ্যা করো।

2. Draw a neat circuit diagram for a full wave rectifier and explain its operation. Calculate the efficiency of rectification. 3+2=5

   চিহ্নিত বর্তনীর সাহায্যে একটি পূর্ণতরঙ্গ একমুখীকারকের কার্যপ্রণালী ব্যাখ্যা করো। এই বর্তনীর দক্ষতার রাশিমালাটি প্রতিষ্ঠা করো।

3. What do you mean by N-type and P-type extrinsic semiconductors? Draw and explain the I-V characteristics of a P-N junction diode both for forward and reverse bias. 2+3=5

   N-type এবং P-type অশুদ্ধ অর্ধপরিবাহী বলতে কী বোঝো? সম্মুখবর্তী এবং বিপরীতমুখী উভয় বায়াসের ক্ষেত্রে P-N সংযোগ ডায়োডের I-V লেখচিত্র অঙ্কন করো এবং ব্যাখ্যা দাও।

4. What is an OP-AMP and why is it called so? Write down the characteristics of an OP-AMP. Explain the concept of virtual ground in an OP-AMP. 1+2+2=5

   OP-AMP বলতে কী বোঝো? এটিকে এরূপ নাম কেন দেওয়া হয়েছে? একটি OP-AMP-এর বৈশিষ্ট্যগুলি উল্লেখ করো। OP-AMP-এর 'অলীক ভূ' (virtual ground) বলতে কী বোঝো ব্যাখ্যা করো।

Section-3

Answer *any one* question. 10×1=10

যে কোনো *একটি* প্রশ্নের উত্তর দাও।

1. What do you mean by biasing a transistor? Why does a transistor need to be biased? Draw a circuit diagram of voltage divider biasing arrangement applied to an *n-p-n* transistor in CE mode. Explain how you can find the Q-point of the circuit. Find the stability factor of the above circuit. 2+2+2+4=10

   ট্রানসিস্টারের বায়াসিং বলতে কী বোঝো? ট্রানসিস্টারকে বায়াস করার প্রয়োজন হয় কেন? CE mode-এ ব্যবহৃত একটি *n-p-n* transistor-এর ভোল্টেজ ডিভাইডার বর্তনীচিত্র অঙ্কন করো। বর্তনীটির Q-point কীভাবে নির্ণয় করবে তা আলোচনা করো। বর্তনীটির stability factor-এর রাশিমালা প্রতিষ্ঠা করো।

2. Given a battery, two switches and an electric bulb. How can an OR gate and an AND gate be constructed? Why are NOR and NAND gates called universal logic gates? Explain.
   Show that
   (i) $\overline{AB} + \overline{A} + AB = 1$
   (ii) $A + \overline{A}B = A + B$ 2+(2+2)+2+2=10

   একটি ব্যাটারি, দুটি সুইচ এবং একটি বৈদ্যুতিক বাতি দেওয়া আছে। এগুলি ব্যবহার করে কীভাবে একটি OR gate এবং একটি AND gate গঠন করা যেতে পারে? NOR এবং NAND gate-কে কেন সার্বজনীন gate বলা হয়? ব্যাখ্যা করো। দেখাও যে
   (i) $\overline{AB} + \overline{A} + AB = 1$
   (ii) $A + \overline{A}B = A + B$

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SH-IV/Physics-404/GE-4(PR)/19

B.Sc. 4th Semester (Honours) Practical Examination, 2019
PHYSICS
(Electronics and Instrumentation Lab)
Paper : 404 GE-4
Course ID : 42424

Time: 2 Hours   Full Marks: 15

The figures in the margin indicate full marks.

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

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি প্রশ্নের পূর্ণমানের নির্দেশক।

পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

1. Draw I-V characteristics of a suitable resistance and that of a junction diode within specified limit on a graph and hence find d.c. and a.c. resistances of both the elements of the point of intersection.

    লেখচিত্রে নির্দিষ্ট সীমার মধ্যে একটি রোধ এবং একটি সংযোগ ডায়োডের I-V বৈশিষ্ট্য লেখগুলি অঙ্কন করো এবং ছেদবিন্দুতে উভয়ের d.c. এবং a.c. রোধ নির্ণয় করো।

    Distribution of marks:

    Theory:

        Working formula with symbols explained and circuit diagram.   2+2=4

    Systematic recording of data and performance:

        Data recording   5

        Graph   2

    Calculation   1

    Accuracy   1

2. Draw the reverse characteristics of the given Zener diode. Obtain the variation of load voltage with load current for the voltage regulator circuit constructed using the same Zener diode. Hence calculate the percentage regulation.

    বিপরীত বায়াসে প্রদত্ত জেনার ডায়োডের বৈশিষ্ট্যলেখ অঙ্কন করো। একই জেনার ডায়োড ব্যবহার করে নির্মিত ভোল্টেজ নিয়ন্ত্রক বর্তনীর জন্যে লোড-প্রবাহের সঙ্গে লোড-বিভবের পরিবর্তন নির্ণয় করো। এর থেকে শতকরা রেগুলেশনের মান নির্ণয় করো।

Distribution of marks:

Theory:

   Working formula with symbols explained and circuit diagrams.   2+(1+1)=4

Systematic recording of data and performance:

Data recording	for reverse characteristics	2
	for load regulation	3
Graph	reverse characteristics	1½
	load regulation	1½

Calculation   1

3. Draw output characteristics of a transistor in CE mode for at least 3 different base currents and hence find $\beta_{d.c.}$ and $\beta_{a.c.}$ at any operating point.

সাধারণ নিঃসারক সংযোগ অবস্থায় কার্যরত একটি ট্রানজিস্টারের আউটপুট বৈশিষ্ট্যলেখ কমপক্ষে তিনটি মানের ভূমি প্রবাহের জন্য অঙ্কন করো এবং যে কোনো একটি কার্যকর বিন্দুতে $\beta_{d.c.}$ এবং $\beta_{a.c.}$ নির্ণয় করো।

Distribution of marks:

Theory:

   Working formula with symbols explained and circuit diagram.   2+2=4

Systematic recording of data and performance:

   Data recording   5

   Graph   2

Calculation   1

Accuracy   1

4. Design a CE amplifier with a given midband gain using voltage divider bias and draw the graph showing variation of voltage gain with frequency for the same.

ভোল্টেজ বিভাজক বায়াস দ্বারা নির্মিত এবং প্রদত্ত মধ্যপট্ট বিবর্ধন ক্ষমতাসম্পন্ন একটি সাধারণ নিঃসারক ভোল্টেজ বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তনের লেখটি অঙ্কন করো।

Distribution of marks:

Theory:

   Definition of amplifier and circuit diagram.   2+2=4

Systematic recording of data and performance:

   Data recording   5

   Graph   2

Calculation   1

Accuracy   1

5. Determine the band gap by measuring the resistance of a thermister at different temperatures.

বিভিন্ন তাপমাত্রায় রোধ নির্ণয়ের মাধ্যমে থার্মিস্টারের পটিবেধ নির্ণয় করো।

Distribution of marks:

Theory:

Definition of the quantity to be measured.	1
Working formula with symbols explained.	1
Circuit diagram	2

Systematic recording of data and performance:

Data recording	5
Graph	2
Calculation	1
Accuracy	1

6. Design an inverting amplifier of given gain using OPAMP (741C) and draw the variation of voltage gain with frequency for the same.

OPAMP (741C) ব্যবহার করে প্রদত্ত বিবর্ধন ক্ষমতাসম্পন্ন একটি বিপরীত দশাকারী বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তন দেখাও।

Distribution of marks:

Theory:

Definition of inverting amplifier using OPAMP	2
Circuit diagram	2

Systematic recording of data and performance:

Data recording	6
Graph	3

7. Design a non-inverting amplifier of given gain using OPAMP (741C) and draw the variation of voltage gain with frequency for the same.

OPAMP (741C) ব্যবহার করে প্রদত্ত বিবর্ধন ক্ষমতাসম্পন্ন একটি সম দশাকারী বিবর্ধক গঠন করো এবং তার কম্পাঙ্কের সঙ্গে ভোল্টেজ বিবর্ধনের পরিবর্তন দেখাও।

Distribution of marks:

Theory:

Definition of non-inverting amplifier using OPAMP	2
Circuit diagram	2

Systematic recording of data and performance:

Data recording	6
Graph	3

8. Construct an adder and a subtractor circuit using full adder IC and verify respective truth-tables.

পূর্ণযোগক IC ব্যবহার করে যোগক এবং বিয়োগক বর্তনী গঠন করো এবং তাদের সংশ্লিষ্ট সত্য-সারণীগুলি প্রতিষ্ঠা করো।

Distribution of marks:

Definition of adder and subtractor	3
Circuit diagram of adder	2
Verification of truth-table of adder	3
Circuit diagram of subtractor	2
Verification of truth-table of subtractor	3

9. Using logic gates simplify the Boolean equations

   (a) $Y = A + \overline{A}B$ and

   (b) $Y = A(\overline{A} + B)$

   construct the circuits and hence compare the truth tables for original and simplified Boolean expressions.

   লজিক গেটসমূহ ব্যবহার করে নিম্নলিখিত বুলীয়ান সমীকরণগুলি সরলীকরণ করো।

   (a) $Y = A + \overline{A}B$ এবং

   (b) $Y = A(\overline{A} + B)$

   প্রতিক্ষেত্রে মূল এবং সরলীকৃত সমীকরণগুলির বর্তনগঠন এবং সত্যসারণীগুলির তুলনা করো।

   Distribution of marks:

Theory	3
Circuit diagram for (1)	2
Verification of truth-table for (1)	3
Circuit diagram for (1)	2
Verification of truth-table for (2)	3

10. Construct NOT, OR, AND and XOR gates from NAND gates and verify respective truth-tables.

    NAND গেট ব্যবহার করে NOT, OR, AND এবং XOR গেট গঠন করো এবং তাদের সংশ্লিষ্ট সত্য-সারণীগুলি প্রতিষ্ঠা করো।

    Distribution of marks:

    Theory:

Definitions of NAND, NOT, OR, AND and XOR gates with respective truth tables.	5

    Systematic recording of data and performance:

Circuit diagram of NOT gate	1
Verification of truth-table of NOT gate	1
Circuit diagram of OR gate	1
Verification of truth-table of OR gate	1
Circuit diagram of AND gate	1
Verification of truth-table of AND gate	1
Circuit diagram of XOR gate	1
Verification of truth-table of XOR gate	1

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B.Sc. 4th Semester (Honours) Practical Examination, 2019

PHYSICS

(Electronics and Instrumentation Lab)

Paper : 404 GE-4

Course ID : 42424

Instructions to the Examiners.

The examiners are requested to paste one question on a card with respective serial number of the question. Cards may be duplicated, but the total number of cards may exceed the number of examinees. A list of arranged experiment sets signed by both the examiners along with answer script packet should be sent to The University. In no case, Examination will be conducted by the Examiner alone. Secrecy of the result must be maintained.

Each candidate should perform the experiment which is noted on the card drawn by him/her. The examiners may, however, use their discretion in offering him/her a second chance only after drawing card by all the candidates. The Laboratory Notebook must be submitted by the candidates before drawing of the card. **No credit should be given to Notebook which has not been signed**.

Candidates are required to write down the questions on one answer-script with respective number of the questions and return the card to the examiner. Candidates will first write down the theory (only for working formula explaining the symbol used) in presence of examiners and get them signed by either of the examiners.

Examiners are requested to see that the candidates are working according to instruction and to sign some important data for the experiment. Each answer script should be examined jointly by the Internal and External and should bear the signature of both examiners. All changes must be initiated by both the examiners. Marks for each item theory, data recording, graph, calculation and accuracy of result must be shown separately. Total marks for experiment should also be shown on the back side of the cover page.

Marks distribution :

Laboratory Notebook —   2

Experiment —   13

If the candidate is found unable to write working formula, it may be supplied by the examiners but no mark on that head will be awarded. Proper handling of the instruments, setting of the apparatus and systematic recording of data should be taken into account while allotting marks for systematic recording of data.

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B.Sc. 4th Semester (Honours) Examination, 2019

PHYSICS

(Radiation Safety)

Paper : 405/SEC-2

Course ID : 42415

Time: 2 Hours   **Full Marks: 40**

The figures in the right hand side margin indicate marks.

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

1. Answer *any five* questions: 2×5=10

   (a) What is binding energy of a nucleus? Where from does this energy come?   1+1=2

   (b) If the stopping potential is given as 2V, what is the maximum kinetic energy of the photoelectrons emitted in Joule?

   (c) What are continuous and characteristics X-ray spectrum?

   (d) Why G.M. counter cannot be used to detect neutrons?

   (e) How many alpha (α) and beta (β) particles are emitted when $^{238}_{92}U$ decays to $^{206}_{82}Pb$?

   (f) What do you understand by stochastic and deterministic effects of radiation exposure?

   (g) What do you mean by Cherenkov radiation?

   (h) Write any two applications of nuclear techniques in industrial uses.

2. Answer *any four* questions: 5×4=20

   (a) (i) Derive the Law of radioactive decay. Draw the curve for number of undecayed nuclei vs. time.

        (ii) Radioactive isotope Indium-III has a lifetime of 2.8 days. What is the initial mass of that substance if the mass after two weeks is 5 kg?   3+2=5

   (b) Write three major differences between GM counter and Scintillation counter.
   It is true that with increase of temperature, the sensitivity of solid state detector increase. Explain your answer.   3+2=5

   (c) Write down the Bethe-Block formula. Define absorbed doses and equivalent dose.   2+3=5

   (d) Write short notes on (i) Nuclear fusion (ii) Pair production.   2½+2½=5

   (e) (i) What are nucleonic gauges? Mention few applications of them.

        (ii) Discuss the different health effects of ionizing radiation.   (1+1)+3=5

   (f) What is an accelerator-driven subcritical reactor? Which is used as fuel in it? In which way the fuel naturally used is better than ^{235}U? What is the importance of such reactor in waste management?   1+1+1½+1½=5

3. Answer *any one* question: 10×1=10

   (a) (i) What is Compton effect? Derive the formula for the Compton shift in the wavelength.

   (ii) A photon of wavelength $\lambda_0 = 0.708$ Å is incident on an electron which is initially at rest. What is the wavelength shift $\Delta\lambda$ at the photon scattering angle $\theta = 30°$ and what is the kinetic energy of the recoiling electron? (1½+3½)+(2½+2½)=10

   (b) (i) Write down the ICRP principles of radiation protection.

   (ii) What do you mean by Nuclear waste? Comment on the disposal management of nuclear waste. 5+(2+3)=10

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