

SH-V/PHS/501/C-11/(P)/19

B.Sc. 5th Semester (Honours) Practical Examination, 2019-20**PHYSICS****Course ID : 52421****Course Code : SH/PHS/501/C-11/P-11****Course Title : Quantum Mechanics and Applications Lab (P-11)****Time: 2 Hours****Full Marks: 15***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words
as far as practicable.*

1. Determination of the ionization potential of mercury/ argon.
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Systematic recording of data 6
 - (d) Graph 3
 - (e) Calculation 1
 - (f) Accuracy 1
2. Study of Electron spin resonance: determine magnetic field as a function of the resonance frequency.
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Systematic recording of data 6
 - (d) Graph 3
 - (e) Calculation 1
 - (f) Accuracy 1
3. Study of Zeeman effect with external magnetic field.
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Systematic recording of data 6
 - (d) Graph 3
 - (e) Calculation 1
 - (f) Accuracy 1
4. Show the tunnelling effect in tunnel diode using I-V characteristics.
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) and show tunnelling effect in theoretical graph 1
 - (c) Systematic recording of data 6
 - (d) Graph 3
 - (e) Accuracy 2

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| 5. | Determination of the quantum efficiency of CCDs. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Systematic recording of data | 6 |
| (d) | Graph | 3 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |
| 6. | Measurement of Planck's constant using black body radiation and photo-detector | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Systematic recording of data | 6 |
| (d) | Graph | 3 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |
| 7. | Determination of the Planck's constant using LEDs of at least 4 different colours. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Systematic recording of data | 6 |
| (d) | Graph | 3 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |
| 8. | Determination of the absorption lines in the rotational spectrum of Iodine vapour. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Systematic recording of data | |
| | (i) Vernier constant of the spectrometer | 1 |
| | (ii) Reading at two position (left & right) of the telescope of spectrometer (Take at least 2 order) | 4+4=8 |
| (d) | Calculation | 1 |
| (e) | Accuracy | 1 |
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*SH-V/PHS/501/C-11/(PI)/19***B.Sc. 5th Semester (Honours) Practical Examination, 2019-20****PHYSICS****Course ID : 52421****Course Code : SH/PHS/501/C-11/P-11****Course Title : Quantum Mechanics and Applications Lab (P-11)***Instruction to the Examiner.*

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.

B.Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52412****Course Code : SHPHS-502-C-12**

Course Title : Solid State Physics

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 practicable.***Section-I**

1. Answer *any five* questions: 1×5=5
- (a) Mention differences between crystalline and amorphous solids.
- (b) Explain the significance of area of hysteresis loop of a ferromagnetic material.
- (c) What is meissner effect?
- (d) Give an example of a crystal that is piezoelectric but not ferroelectric.
- (e) What is the number of nearest neighbour in a bcc crystal?
- (f) Define effective mass of an electron in a solid.
- (g) What are the origins of magnetic moment in an atom?
- (h) Obtain the Miller indices of a plane having intercepts of $\frac{a}{2}, \frac{b}{3}, \infty$ on the a, b and c axes, respectively.

Section-IIAnswer *any two* questions: 5×2=10

2. (a) The primitive translation vectors of a hexagonal space lattice are,

$$\vec{a} = \left(\frac{\sqrt{3}}{2}a\right)\hat{i} + \left(\frac{a}{2}\right)\hat{j}$$

$$\vec{b} = -\left(\frac{\sqrt{3}}{2}a\right)\hat{i} + \left(\frac{a}{2}\right)\hat{j}$$

$$\vec{c} = c\hat{k}$$

find the volume of the primitive cell.

- (b) Derive the expression for interplanar spacing between two parallel planes with Miller indices (hkl) . Show that for cubic crystal of lattice constant ' a ' is given by,

$$d_{hkl} = \frac{a}{\sqrt{h^2+k^2+l^2}} \quad \text{2+3=5}$$

3. (a) What is Hall effect?
(b) Derive an expression of Hall coefficient of a material. 1+4=5
4. (a) What is meant by induced and orientational polarizability?
(b) Derive the Clausius-Mosotti equation relating to polarizability and dielectric constant of a solid. 1+4=5
5. Explain the concept of BCS Theory and BCS ground state. 5

Section-III

Answer *any one* of the following: 10×1=10

6. (a) Derive the number of vibrational modes of a crystalline solid in the frequency range γ and $\gamma + d\gamma$.
Hence obtain an expression for Debye temperature and explain the significance of Debye cut-off frequency.
(b) Now calculate the specific heat at very low temperature and high temperatures. Interpret the result. 2+2+5+1=10
7. (a) What is paramagnetism? What is the essential difference between the classical and quantum theory of paramagnetism?
(b) Using the quantum theory of paramagnetism derive an expression for paramagnetic susceptibility at ordinary fields and temperatures. 1+1+8=10
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SH-V/PHS/502/C-12/(P)/19

B.Sc. 5th Semester (Honours) Practical Examination, 2019-20**PHYSICS****Course ID : 52422****Course Code : SHPHS-502-C-12**

Course Title : Solid State Physics

Time: 2 Hours**Full Marks: 15***The figures in the margin indicate full marks.**The questions are equal value.*

1. Measure the susceptibility of paramagnetic solution (Quinck's Tube Method).
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Circuit diagram 2
 - (d) Recording of data + graph 5+2=7
 - (e) Calculation 1
 - (f) Accuracy 1
2. Measure the magnetic of susceptibility of solids.
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Circuit diagram 2
 - (d) Recording of data 7
 - (e) Calculation 1
 - (f) Accuracy 1
3. Determine the coupling coefficient of a piezoelectrical crystal.
 - (a) Definition of the quantity to be measured 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Circuit diagram 2
 - (d) Recording of data 7
 - (e) Calculation 1
 - (f) Accuracy 1
4. Measure the dielectric constant of a dielectrical material with frequency (or at a fixed frequency).
 - (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbols) 1
 - (c) Circuit diagram 2
 - (d) Recording of data 7
 - (e) Calculation 1
 - (f) Accuracy 1

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| 5. | Determine the refractive index of a dielectric layer using SPR. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbol) | 1 |
| (c) | Setting of apparatus | 2 |
| (d) | Recording of data | 7 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |
| 6. | Draw the BH curve of Fe using solenoid and determine energy loss form Hysteresis. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Circuit diagram | 2 |
| (d) | Recording of data | 5 |
| (e) | Graph plotting | 2 |
| (f) | Calculation | 1 |
| (g) | Accuracy | 1 |
| 7. | Measure the resistivity of a semiconductor (Ge) with temperature by four probe method and to determine its band gap. | |
| (a) | Definition of the quantity to be determined (band gap) | 1 |
| (b) | Theory (working formula with explanation of the symbols) | 1 |
| (c) | Circuit diagram | 2 |
| (d) | Recording of data | 5 |
| (e) | Drawing graph | 2 |
| (f) | Calculation | 1 |
| (g) | Accuracy | 1 |
| 8. | Determine the Hall coefficient of a semiconductor sample. | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Circuit diagram | 2 |
| (d) | Data recording + Graph | 5+2 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |
| 9. | Determine the complex dielectric constant and plasma frequency of metal using Surface Plasma Resonance (SPR). | |
| (a) | Definition of the quantity to be determined | 1 |
| (b) | Theory (working formula with explanation of symbols) | 1 |
| (c) | Circuit diagram | 2 |
| (d) | Data recording | 7 |
| (e) | Calculation | 1 |
| (f) | Accuracy | 1 |

- 10.** Study the PE Hysteresis loop of a ferroelectric crystal
- (a) Definition of the quantity to be determined 1
 - (b) Theory (working formula with explanation of symbol) 1
 - (c) Circuit diagram 2
 - (d) Data recording 6
 - (e) Graph plotting 2
 - (f) Calculation 1
 - (g) Accuracy 1
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*SH-V/PHS/502/C-12/(PI)/19***B.Sc. 5th Semester (Honours) Practical Examination, 2019-20****PHYSICS****Course ID : 52422****Course Code : SH/PHS/502/C-12**

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Instruction to the Examiner.

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Experiment—13

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SH-V/PHS/503/DSE-1/19

B.Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52416****Course Code : SHPHS/503/DSE-1**

Course Title : Advanced Mathematical Physics

Time: 2 Hours**Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer *any five* of the following: 2×5=10
- What do you mean by Direction Cosines?
 - What do you mean by Invariant tensor?
 - What is the Quotient law of Tensors?
 - What is antisymmetric tensor?
 - Write down the condition for two lines to be coplanar.
 - Find the probability of drawing 2 aces in succession from a pack of 52 cards.
 - Give an example of a finite ordered element in an infinite group.
 - Define normal subgroup of a group.
2. Answer *any four* of the following: 5×4=20
- What do you mean by Gradient, Divergence and curl of Tensor fields?
 - Define Covariant, Contra variant and mixed tensors.
 - Write down moment of Inertia tensor, stress and strain tensors.
 - If the probability of a bad reaction from a medicine is 0.001, determine the change that out of 2000 individuals more than two will get a bad reaction.
 - Prove that for any group G , $G/Z(G)$ is cyclic if and only if G is abelian, where $Z(G)$ is the centre of G .
 - Prove that for any group homomorphism $f : G_1 \rightarrow G_2$, $\ker f$ is a normal subgroup.
3. Answer *any one* question: 10×1=10
- Let G be a group prove that G is cyclic if and only if there exists an element $a \in G$ such that $O(a) = (G)$
 - Give an example of a non-commutative group whose all the subgroup are normal.
 - Are the groups (\mathbb{C}^*, \cdot) and (\mathbb{R}^*, \cdot) isomorphic to each other? Justify your answer.
 - State Schur's lemma. 5+2+2+1=10

- (b) (i) Write down generalized Hooke's law.
- (ii) What do you mean by Minkowski space?
- (iii) What do you mean by Kroneker Delta? Discuss its property.
- (iv) Define permutation Tenser.
- (v) Discuss with an example product of two tensors.

2+2+2+2+2=10

B.Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52416****Course Code : SHPHS-503-DSE-1****Course Title : Classical dynamics****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.***Section-I**

1. Answer *any five* of the following: 2×5=10
- Find the Lagrangian for simple pendulum.
 - An electron of rest mass 9.2×10^{-31} kg is moving with a speed $0.99C$. What is total energy, where $C = 3 \times 10^8$ m/s.
 - Two photons approach each other. What is their relative velocity.
 - Show that kinetic energy remain constant when a charge particle move in uniform magnetic field.
 - The potential energy of a particle is a given by the expression $V(x) = x^4 - 4x^3 - 8x^2 + 48x$. Find the points of unstable equilibrium.
 - Explain turbulence in fluid dynamics with examples.
 - Show that if a given co-ordinate is cyclic in Lagrangian, it will be cyclic in Hamiltonian.
 - An electron emitted from a hot filament is accelerated through a potential difference of 18kV and enters a region of a uniform magnetic field 0.1T with certain initial velocity. What is the trajectory of the electron if the magnetic field is transverse to the initial velocity?

Section-IIAnswer *any four* of the following: 2×5=5

- What is light cone? What is world line? Draw typical space-time diagram. 1+2+2=5
- (a) Established the relation $E^2 = p^2 c^2 + m_0^2 c^4$, symbols have their usual meaning. 3
- (b) A pion at rest decays into a muon and neutrino. Show that the momentum of the muon is given by $|\bar{P}_M| = \frac{c(m_\pi^2 - m_\mu^2)}{2m_\pi}$, Symbols have their usual meaning. 2

4. A charge particle initially moving in the x -direction with a velocity V_{ox} be subjected to a uniform electric field E in the K direction and a uniform magnetic field B in the z direction. Find the velocity of charge particle at any instant of time t . 5
5. (a) Derive an expression for Laplace-Runge-Lenz Vector.
 (b) Prove that the speed of a particle moving in an elliptic path in an inverse square field $f(r) = -\frac{K}{r^2}$ is given by $V^2 = \frac{K}{m} \left(\frac{2}{r} - \frac{1}{a} \right)$, where a is the semi-major axis, m is the mass of particle. 3+2=5
6. Explained
 (i) Minkowski space
 (ii) Invariant interval
 (iii) Space like
 (iv) Time-like
 (v) Light like 1+1+1+1+1=5
7. (a) What are the characteristics of ideal fluid?
 (b) Write the general form of Navier-Stokes equation and state one application of it. 2+2+1=5

Section-III

Answer *any one* question.

10×1=10

8. Two masses each equal m , are connected by massless springs of spring constant k such that they can freely slide on a smooth horizontal surface. The ends of springs are fixed to vertical walls. Determine
 (i) the normal frequency.
 (ii) the normal modes vibration.
 (iii) the normal coordinate 3+4+3=10
9. (a) Given the Lagrangian $L = \frac{1}{2}m(\dot{r}^2 + r^2 \dot{\theta}^2) - V(r)$. Find the Hamiltonian and hence the equation of motion. (Symbols have their usual meaning)
 (b) Show that the total energy will remain constant for a particle motion in central force field. 6+4=10
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SH-V/PHS/504/DSE-2/19

B.Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52417****Course Code : SH/PHS/504/DSE-2**

Course Title : Astronomy and Astrophysics

Time: 2 Hours**Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

1. Answer *any five* of the following: 2×5=10
- (a) What do you mean by astronomical distance?
 - (b) Discuss about stellar Radii.
 - (c) What is solar flare?
 - (d) Distinguish between Absolute and Apparent luminosity of a star.
 - (e) What is an Asteroid?
 - (f) What are binary stars?
 - (g) What do you mean by Chandrashekhar limit?
 - (h) What do you mean by apparent solar time?
2. Answer *any four* of the following: 5×4=20
- (a) What are pulsars?
 - (b) Write short note on Hubble space telescope.
 - (c) How is the rotational period of a stars obtain from its spectra?
 - (d) Distinguish between Reflecting and Refracting telescope.
 - (e) How can be measured distance by Parallax method?
 - (f) Compare between Apparent and Absolute magnitude scale.
3. Answer *any one* question: 10×1=10
- (a) (i) Discuss about Hubble classification of Galaxies.
 (ii) What do you mean by galactic Halo?
 (iii) Write a short note Milkyway Galaxy. 5+1+4=10
 - (b) (i) Write a short note on Hertzsprung-Russel Diagram.
 (ii) State and prove Hubble Law.
 (iii) What do you mean by Dark Matter?

Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52417****Course Code : SH/PHS/504/DSE-2****Course Title : Nuclear and Particle Physics****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.***Section-I**

1. Answer *any five* of the following: 2×5=10
- (a) Define cross section of Nuclear reaction. What is its physical significance? 1+1=2
- (b) What are the quark composition of Π^+ and Π^0 . 2
- (c) Given the atomic mass of ${}^2_1\text{H}$ to be $2.0141 u$, calculate the maximum wavelength of a photon which can split a deuteron. 2
- (d) Find the ground state spin parity ${}^{16}_8\text{O}$ and ${}^{31}_{15}\text{P}$. 2
- (e) Calculate the maximum kinetic energy of the electron emitted in the β -decay of free neutron. The neutron-proton mass difference is 1.30 MeV . 2
- (f) Write down the differences between compound Nuclear reaction and direct reaction. 2
- (g) Write down Bethe-Bloch formula for energy loss through ionization. What is Cherenkov radiation? 1+1=2
- (h) Write down the experimental evidences regarding the nuclear shell model concept. 2

Section-II

2. Answer *any four* of the following: 5×4=20
- (a) What is Compton scattering? Find the wavelength shift through Compton's scattering for gamma interaction with matter. Does Compton Scattering occurs for visible light? 1+3+1=5
- (b) Discuss the working principle of semiconductor detector for charge particle detection. What kind of materials are used for neutron detection? Give a process of neutron detection. 3+1+1=5
- (c) Draw the 'Binding energy per Nucleon' vs 'mass number' graph and briefly explain how this graph helps to understand the phenomena of 'nuclear fission', 'nuclear fusion' and saturation property of nuclear force. 1+4=5
- (d) What is neutrino? What lead Pauli to put forward the neutrino hypothesis? How this hypothesis solves the apparent breakdown of conservation of momentum and energy in β -decay. 1+2+2=5
- (e) Explain the working principle of a cyclotron. Why electrons are not accelerated to high energies using cyclotron. 3+2=5

(f) In the following pairs, determine which of the reactions are possible:

- (i) $\Pi^- + p \rightarrow \Sigma^0 + \eta^0$
 $\Pi^- + p \rightarrow \Sigma^0 + k^0$ (Strong interaction)
- (ii) $\Sigma^- \rightarrow \pi^- + \eta$
 $\Sigma^- \rightarrow \pi^- + p$ (Weak decay)
- (iii) $\eta \rightarrow p + e^- + \gamma_e$
 $\eta \rightarrow p + e^- + \bar{\nu}_e$ (Weak decay)

Section-III

3. Answer *any one* question:

10×1=10

- (a) What is meant by the range of an α -particle? How does the range of α -particles in matter depend on energy? Explain Geiger-Nuttall law relating the range of α -particles and decay constant.

Draw the schematic diagram of energy loss $\left(-\frac{dE}{dx}\right)$ of Alpha, proton, deuteron and muons as a function of energy (E) while they are passing through a medium. Explain the fine structure of α -ray spectrum with the help of proper energy level diagram. 1+2+2+2+3=10

- (b) Discuss Rutherford's alpha particle scattering theory with suitable mathematical analysis.

Discuss qualitatively how γ -ray interact with matter while passing through it.

In a scintillation detector, a γ -ray peak of 20 keV energy is observed at a pulse height of 32 volt. The full width at half maxima is 4 keV. Evaluate the percentage resolution of the detector. 5+3+2=10

SP-V/PHS/504/SEC-3/19

B.Sc. 5th Semester (Programme) Examination, 2019-20**PHYSICS****Course ID : 52410****Course Code : SP/PHS/504/SEC-3****Course Title: Electrical Circuits and Network Skills****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.*

দক্ষিণ প্রান্তস্থ সংখ্যাগুলি প্রশ্নের পূর্ণমানের নির্দেশক।
পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।

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

যে কোনো পাঁচটি প্রশ্নের উত্তর দাও :

- (a) What do you mean by resistivity of a conductor? Mention the unit of resistivity.
কোনো পরিবাহীর রোধঙ্ক বলতে কী বোঝো? রোধঙ্কের একক উল্লেখ করো।
- (b) While a capacitor still connected to a power source what will be the potential difference between the plates when the spacing between them is halved?
তড়িৎ উৎসযুক্ত অবস্থায় যদি কোনো ধারকের পাতদ্বয়ের দূরত্ব অর্ধেক করা হয় তাহলে পাতদ্বয়ের মধ্যে বিভব প্রভেদের মান কত হবে?
- (c) What do you mean by active and passive circuits?
সক্রিয় ও নিষ্ক্রিয় বর্তনী বলতে কী বোঝো?
- (d) Why the internal barrier developed in a pn junction diode does not send any current in the external circuit?
pn সংযোগ ডায়োডে সৃষ্ট আভ্যন্তরীণ বাধা বিভব কেন বহিস্থঃ বর্তনীতে তড়িৎ প্রবাহ পাঠাতে পারে না?
- (e) What do you mean by back emf in relation to a d.c. motor?
একটি মোটরের ক্ষেত্রে 'বিরুদ্ধ তড়িচ্চালক বল' বলতে কী বোঝো?
- (f) What do you mean by Wattless current?
ক্ষমতাহীন তড়িৎ প্রবাহ বলতে কী বোঝো?
- (g) What is the relation between fusing current and diameter of a wire?
কোনো পরিবাহীর ক্ষেত্রে ফিউজ প্রবাহের সঙ্গে তার ব্যাসের সম্পর্ক কী?
- (h) What is meant by forward and reverse biasing of a semiconductor diode?
একটি অর্ধপরিবাহী ডায়োডের সম্মুখবর্তী এবং বিপরীত বায়াস বলতে কী বোঝো?

Group-B

Answer any four questions:

5×4=20

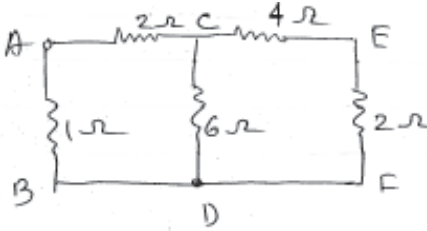
যে কোনো চারটি প্রশ্নের উত্তর দাও :

2. Define Ohm's law. What are ohmic and non ohmic conductors? Establish Ohm's law on the basis of electron drift velocity in a conductor. 1+2+2=5

ওহমের সূত্র বিবৃত করো। ওহমীয় এবং অওহমীয় পরিবাহী বলতে কী বোঝো? কোনো পরিবাহীর অনুপ্রবাহ বেগের সাপেক্ষে ওহমের সূত্রটি প্রতিষ্ঠা করো।

3. What do you mean by equivalent resistance? Find the equivalent resistance of the given circuit between (i) A and B and (ii) C and D. 1+2+2=5

তুল্য রোধ বলতে কী বোঝো? প্রদত্ত বর্তনীটির (i) A এবং B ও (ii) C এবং D এর মধ্যে তুল্য রোধ নির্ণয় করো।



4. How a galvanometer can be converted into an ammeter and a voltmeter? Draw the necessary circuit diagrams. 3+2=5

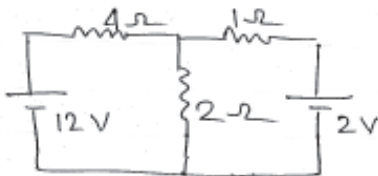
একটি গ্যালভানোমিটারকে কীভাবে অ্যামিটার এবং ভোল্টমিটারে রূপান্তরিত করা যায়? প্রয়োজনীয় বর্তনীগুলি অঙ্কন করো।

5. What is a dc motor? Describe with a circuit diagram the functioning of a dc motor. 1+4=5

dc মোটর কী? চিত্রসহ একটি dc মোটরের কার্যপ্রণালী ব্যাখ্যা করো।

6. State Kirchoff's laws. Applying Kirchoff's laws determine the current flowing through 1Ω resistance in the following circuit. 2+3=5

কির্সফের সূত্রগুলি বিবৃত করো। নিম্নে প্রদর্শিত বর্তনীতে কির্সফের সূত্র প্রয়োগ করে 1Ω রোধের মধ্যে তড়িৎ প্রবাহমাত্রা নির্ণয় করো।



7. How does a depletion layer form in a semiconductor diode? How does the width of this region

change when the diode is forward and reverse biased? What is Zener Breakdown? 2+1+2=5
 অর্ধপরিবাহী ডায়োড কীভাবে নিঃশেষিত অঞ্চল গঠিত হয়? ডায়োডের সম্মুখবর্তী এবং বিপরীত বায়াসের ক্ষেত্রে এই অঞ্চলের বেধ কীভাবে পরিবর্তিত হয়?

Group-C

Answer any one question:

10×1=10

যে কোনো একটি প্রশ্নের উত্তর দাও :

8. What is a transformer? Describe with a neatly labelled circuit diagram the principle of action of a transformer. Enumerate different types of losses in a practical transformer. How are these losses reduced? 1+4+2+3=10

ট্রান্সফর্মার কী? পরিষ্কার চিত্র সহযোগে একটি ট্রান্সফর্মারের কার্যনীতি ব্যাখ্যা করো। একটি বাস্তব ট্রান্সফর্মারের বিভিন্ন প্রকার শক্তিক্ষয়গুলি বিবৃত করো। এই শক্তিক্ষয়গুলি কীভাবে কমানো যায়?

9. What do you mean by rectification of an ac signal? With the help of a circuit diagram explain the use of a pn junction diode as a full wave rectifier giving its input and output waveforms. What are the advantages of a full wave rectifier over a half wave rectifier? 1+6+3=10

ac সিগন্যালের একমুখীকরণ বলতে কী বোঝো? পরিষ্কার চিত্রসহযোগে একটি pn সংযোগ ডায়োড ইনপুট এবং আউটপুট তরঙ্গসহ একমুখীকারক হিসাবে কীভাবে কাজ করে তার ব্যাখ্যা দাও। অর্ধতরঙ্গ একমুখীকারকের তুলনায় পূর্ণতরঙ্গ একমুখীকারক ব্যবহারের সুবিধাগুলি কী কী?

B.Sc. 5th Semester (Programme) Examination, 2019-20

PHYSICS

Course ID : 52410

Course Code : SP/PHS/504/SEC-3

Course Title: Physics Workshop Skill

Time: 2 Hours

Full Marks: 40

The figures in the margin indicate full marks.

*Candidates are required to give their answers 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 questions:

2×5=10

যে কোনো পাঁচটি প্রশ্নের উত্তর দাও :

(a) What are the uses of Multimeter?

মাল্টিমিটারের ব্যবহার কী?

(b) What is the meaning of SI units? The density of copper is 8.83 Kg/am^3 . Express it in Kg/m^3 .

SI এককের অর্থ কী? কপারের ঘনত্ব 8.83 Kg/am^3 । এই ঘনত্বকে Kg/m^3 এককে প্রকাশ করো।

(c) What is the requirement of using lever?

লিভার ব্যবহারের প্রয়োজনীয়তা কী?

(d) Discuss about the welding defects.

ওয়লডিং-এর ত্রুটিগুলো আলোচনা করো।

(e) How do you measure the diameter of a thin wire?

সরু তারের ব্যাস কীভাবে মাপবে, আলোচনা করো।

(f) What is PCB?

PCB কী?

(g) What is the utility of vernier scale and screw gauge?

ভার্নিয়ার স্কেল এবং স্ক্রু গেজের ব্যবহার কী?

(h) What is the Horizontal sweeping of oscilloscope?

Oscilloscope-এর হরাইজেন্টাল sweeping আলোচনা করো।

2. Answer any five questions:

যে কোনো পাঁচটি প্রশ্নের উত্তর দাও :

(a) Discuss how to measure the height of buildings using sextant.

যন্ত্রের সাহায্যে কীভাবে একটা বাড়ির উচ্চতা মাপবে, আলোচনা করো।

(b) Discuss the mechanism of Vernier Calliper and screw gauge.

ভার্নিয়ার ক্যালিপার এবং স্ক্রু-গেজের কার্যপ্রণালী আলোচনা করো।

- (c) A Vernier Callipers has 1mm marks on the main scale. It has 20 equal division on the vernier scale which match with 16 main scale division. Calculate the least count for the vernier scale.

একটা ভার্নিয়ার ক্যালিপার্সের মূলস্কেলে 1mm সর্বনিম্ন আছে। এর মোট 20টি ভাগ আছে ভার্নিয়ার স্কেলে যা মূল স্কেলের 16 ঘরের সাথে মিশে যায়। লিস্ট কাউন্ট বের করো।

- (d) Discuss regarding the drilling of holes of different diameter in metal sheets and wooden block.

ধাতব পাত এবং কাঠের ব্লকে ড্রিলের ছিদ্রের ব্যাস সম্পর্কে আলোচনা করো।

- (e) How do you make timer circuit and electronic switching using transistor and relay?

ট্রানসিস্টার এবং রিলে ব্যবহার করে কীভাবে টাইমার সার্কিট ও ইলেকট্রনিক্স সুইচ তৈরি করবে?

- (f) What kind of lever will you use to lift a heavy weight object. Discuss in details.

একটা ভারী বস্তুকে তোলার জন্য কী কী ধরনের লিভার ব্যবহার করবে? আলোচনা করো।

3. Answer any one question:

10×1=10

যে কোনো একটি প্রশ্নের উত্তর দাও :

- (a) Write down the working principle of power generation system. Discuss the soldering of electrical circuits.

5+5=10

শক্তি উৎপাদন ব্যবস্থার কার্যনীতি আলোচনা করো। ইলেকট্রিক্যাল সার্কিটের soldering আলোচনা করো।

- (b) What are the common material used for manufacturing? How do you make a regulated power supply? Draw a schematic diagram of regulated power supply. What is Breaking system? Discuss shortly about the pulley experiment. 2+2+2+2+2=10

ম্যানুফেকচারিং-এ কী কী ধরনের পদার্থ ব্যবহার করা হয়? কীভাবে একটা রেগুলেটেড power supply বানাবে? রেগুলেটেড power supply-এর schematic চিত্র আঁকো। ব্রেকিং সিস্টেম কী? Pulley experiment সম্পর্কে সংক্ষেপে আলোচনা করো।

SP-V/PHS/501/DSE-1A/19

B.Sc. 5th Semester (Programme) Examination, 2019-20**PHYSICS****Course ID : 52418****Course Code : SP/PHS/501/DSE-1A****Course Title : Classical Dynamics****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.**দক্ষিণ প্রান্তস্থ সংখ্যাগুলি পূর্ণমান নির্দেশক।
পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।***Section-I****1. Answer any five questions: 2×5=10***যে কোনো পাঁচটি প্রশ্নের উত্তর দাও :*

(a) What do you mean by generalised coordinate?

Generalised coordinate বলতে কী বোঝো?

(b) What do you understand by stable and unstable equilibrium?

স্থিতিশীল ভারসাম্য ও অস্থিতিশীল ভারসাম্য বলতে বোঝো?

(c) What is gyro-radius and gyro-frequency?

Gyro-radius এবং gyro-frequency কী?

(d) Give the example of massless particle or particle with rest mass zero. What is the velocity of the particle?

স্থিরভর শূন্য এইরূপ কণার উদাহরণ দাও। এই কণার ক্ষেত্রে গতিবেগ কত?

(e) What do you mean by lagrangian of the system?

তন্ত্রের Lagrangian বলতে কী বোঝো?

(f) In which condition, Hamiltonian (H) represents the total energy of the system?

কোন শর্তে, Hamiltonian (H) তন্ত্রের মোট শক্তিকে প্রকাশ করে?

(g) Write down the postulates of the special theory of relativity.

আপেক্ষিকতাবাদের বিশেষ তন্ত্রের স্বীকার্যগুলি লেখো।

(h) What are 'inertial frames of reference'?

জড়ত্বীয় নির্দেশতন্ত্র কাদের বলে?

Section-II

Answer any four questions:

5×4=20

যে কোনো চারটি প্রশ্নের উত্তর দাও :

2. Find out the Hamiltonian of simple pendulum and then establish the equation of motion. What is the advantages of Hamiltonian approach? 2+2+1=5

সরল দোলকের Hamiltonian-এর মান বের করো এবং তা থেকে সরল দোলকের গতির রাশিমালাটি নির্ণয় করো। Hamiltonian approach-এর সুবিধা লেখো।

3. A charged particle is introduced in a uniform magnetic field \vec{B} along any arbitrary direction with velocity \vec{V} making an angle θ with \vec{B} . How will be shape of the path of the charge particle? Explain it.

A positron of kinetic energy 200 eV is projected at an angle 30° with respect to the direction of uniform field of induction $B = 10^{-2}$ tesla calculate the radius of the spiral path? 2+3=5

একটি তড়িতাঙ্কিত কণাকে সুযম চুম্বক ক্ষেত্রে (\vec{B}) \vec{V} গতিবেগে এবং \vec{B} -এর সাথে θ কোণে প্রবেশ করানো হল। তড়িতাহিত কণাটির গতিপথের আকৃতি কেমন হবে, ব্যাখ্যা করো।

200 eV গতিশক্তি সম্পন্ন কোনো পজিট্রনকে সুযম চুম্বকক্ষেত্র (field of induction) $B = 10^{-2}$ -এর সাথে 30° কোণে প্রবেশ করানো হল। সর্পিলা পথের ব্যাসার্ধ নির্ণয় করো।

4. What is length contraction and time dilation? Prove that length of a moving rod is always shorter than its proper length. 2+3=5

দৈর্ঘ্যের আপাত সংকোচন ও সময়ের আপাত বিস্তৃতি বলতে কী বোঝো? প্রমাণ করো যে, কোনো গতিশীল রডের দৈর্ঘ্য তার প্রাপ্য দৈর্ঘ্যের (proper length) থেকে সর্বদা ছোটো হবে।

5. Explain relativistic Doppler effect. What do you mean by time-like and space-like intervals? 3+2=5

আপেক্ষিকতাবাদ সংক্রান্ত ডপলার ক্রিয়া ব্যাখ্যা করো। time-like এবং space-like intervals বলতে কী বোঝো?

6. The potential energy of a particle is given by

$$V(x) = x^4 - 4x^3 - 8x^2 + 48x$$

Find the points of stable and unstable equilibrium. Explain the terms (i) normal frequencies (ii) normal modes of vibrations. 3+2=5

কোনো কণার স্থিতিশক্তি হল নিম্নরূপ

$$V(x) = x^4 - 4x^3 - 8x^2 + 48x$$

স্থিতিশীল ভাগসাম্য ও অস্থিতিশীল ভাগসাম্য বিন্দু নির্ণয় করো। (i) নরমাল (normal) কম্পাঙ্ক (ii) নরমাল (normal) মোড, — বিষয়গুলি ব্যাখ্যা করো।

7. A particle of mass m moves in a plane in the field of force given by $\vec{F} = -\hat{r} kr \cos \theta$ where k is a constant and \hat{r} is the radius unit vector. Show that $mr^2\dot{\theta} = \text{constant}$. What do you mean by conservative force? 4+1=5

কোনো সমতলে, m ভরের একটি কণা $\vec{F} = -\hat{r} kr \cos \theta$ বলের ক্ষেত্রে গতিশীল, যেখানে k হল একটি ধ্রুবক এবং \hat{r} হল \vec{r} বরাবর একক ভেক্টর। দেখাও যে $mr^2\dot{\theta} = \text{ধ্রুবক}$ । সংরক্ষী বল বলতে কী বোঝো?

Section-IIIAnswer *any one* question:

10×1=10

8. Derive the equations of Lorentz transformation. Establish the relation $E^2 \equiv p^2 c^2 + m_0^2 c^4$ for a particle of rest mass m_0 , momentum P and total energy E . What is twin paradox? 5+3+2=10
লোরেঞ্জ রূপান্তর সমীকরণগুলি প্রতিষ্ঠা করো। $E^2 \equiv p^2 c^2 + m_0^2 c^4$ সম্পর্কটি প্রতিষ্ঠা করো, যেখানে m_0 হল কণার স্থির ভর, P হল ভরবেগ এবং E হল মোট শক্তি। Twin paradox কী?
9. What is meant by an ideal fluid? What is the significance of Reynolds number? Derive Navier-Stokes equation. For what condition, Navier-Stokes equation can be solved? 1+2+5+2=10
আদর্শ প্রবাহী বলতে কী বোঝো? রেনল্ড সংখ্যার তাৎপর্য লেখো। Navier-Stokes-এর সমীকরণটি নির্ণয় করো। কোন শর্তে Navier-Stokes সমীকরণ সমাধান করা সম্ভব?
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B.Sc. 5th Semester (Programme) Examination, 2019-20**PHYSICS****Course ID : 52418****Course Code : SP/PHS/501/DSE-1A****Course Title : Advanced Mathematical Physics****Time: 2 Hours****Full Marks: 40***The figures in the margin indicate full marks.**Candidates are required to give their answers in their own words as far as practicable.**দক্ষিণ প্রান্তস্থ সংখ্যাগুলি পূর্ণমান নির্দেশক।
পরীক্ষার্থীদের যথাসম্ভব নিজের ভাষায় উত্তর দিতে হবে।*

1. Answer *any five* questions: 2×5=10
 - (a) Show that gradient of a scalar function is a tensor of order one.
 - (b) Find the second order anti-symmetric tensor associated with the vector: $2\hat{i} - 3\hat{j} + \hat{k}$.
 - (c) Prove that product of tensors of rank one is a tensor of rank two.
 - (d) Show that $\vec{A} \times \vec{B}$ transforms like tensor of rank one.
 - (e) Show that $A^\mu B^\mu$ is invariant.
 - (f) Define Quotient Law.
 - (g) What do you mean by cyclic group?
 - (h) Prove that every cyclic group is abelian.

 2. Answer *any four* questions: 5×4=20
 - (a) Show that: $\epsilon_{iks}\epsilon_{mps} = \delta_{im}\delta_{kp} - \delta_{ip}\delta_{km}$.
 - (b) Define kronecker-delta function, Show that it is
 - (i) an isotropic tensor,
 - (ii) a symmetric tensor of order 2. 1+2+2=5
 - (c) Derive an expression for the Moment of Inertia tensor.
 - (d) Prove that Moment of Inertia is a symmetric tensor and it transform like a second order tensor.
 - (e) A man is known to speak truth 2 out of 3 times. He throws a die and reports that number obtained is a four. Find the probability that the number obtained is actually a four.
 - (f) Show that if H and K are subgroups of an abelian group G , then $\{hk|h \in H, k \in K\}$ is subgroup of G .

 3. Answer *any one* question: 10×1=10
 - (a) Using tensors, prove the following identities:
 - (i) $\vec{\nabla} \times (\phi\vec{A}) = \phi(\vec{\nabla} \times \vec{A}) + (\vec{\nabla}\phi) \times \vec{A}$
 - (ii) $\vec{\nabla} \times (\vec{\nabla} \times \vec{A}) = \vec{\nabla}(\vec{\nabla} \cdot \vec{A}) - \nabla^2 \vec{A}$
 - (b) Define pure strain Tensor e_{ij} . Establish that it is a symmetric tensor of order 2. Also give the physical significance of its components e_{11} and e_{12} .
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SH-V/PHS/501/C-11/19

B.Sc. 5th Semester (Honours) Examination, 2019-20**PHYSICS****Course ID : 52411****Course Code : SH/PHS/501/C-11**

Course Title : Quantum Mechanics and Applications

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 practicable.***Section-I**

1. Answer *any five* questions: 1×5=5
- What is the ionization energy of a hydrogen atom if the atom is in its first excited state?
 - State Hund's rule.
 - Show that the relation $[L_x, L_y] = i\hbar L_z$ is valid for the x , y and z components of L .
 - What are the requirements that a function should obey to describe properly the state of a particle?
 - What is the physical significance of normalization of wave function in Quantum Mechanics?
 - Write down the expression of Larmour frequency.
 - Name two experimental observations which support the existence of spin of electrons.
 - Write down the expression of probability current density in 3D.

Section-IIAnswer *any two* questions: 5×2=10

- What do you mean by stationary states? Starting from the time-dependent Schrödinger equation, find the time-independent Schrödinger equation that is satisfied by the wave functions for stationary states.
- Considering the Gaussian wave function in momentum space $\phi(P_x) = e^{-(P_x - P_0)^2/r^2}$. Establish the position momentum uncertainty principle. (The symbols have their usual meaning). 5
- Determine the orbital magnetic moment of an electron moving in a circular orbit of radius r about a proton. Calculate the frequency at which an electron's orbital magnetic moment precesses in a magnetic field \vec{B} . 2+3=5
- Given the normalized eigen function for the ground state of hydrogen atom is $\psi_0 = \frac{1}{\sqrt{\pi a_0^3}} e^{-r/a_0}$,

where a_0 is the Bohr radius.Show that the electron density in the hydrogen is maximum at $r = a_0$. 5

Section-III

Answer *any one* of the following questions:

10×1=10

6. What are the normal and anomalous Zeeman effect? Give the theory of Zeeman effect when the atom is placed in weak magnetic field and explain the results in the context of Na D-lines.

What happens if the magnetic field is increased to a high value?

1+(6+2)+1=10

7. Show that an appropriate boundary condition on the solution of the Schrödinger equation for the linear harmonic oscillator leads to the discrete spectrum of its energy.

Find the probability of finding the linear harmonic oscillator within classical limits. Given the ground state wave function of the linear harmonic oscillator is

$$\psi(x) = \left(\frac{m\omega}{\pi\hbar}\right)^{1/4} \exp\left[-\frac{1}{2}\left(\frac{m\omega}{\hbar}\right)x^2\right], \text{ where the symbols have their usual meanings.} \quad 7+3=10$$
