K.L.E. Society's

Raja Lakhamagouda Science Institute

(Autonomous)

BELAGAVI.

SUBJECT

M.Sc. II - Semester

Mathematics

June-2017

QUESTION PAPER BOOKLET

Reg. No. | | | | | | | | |

KLE Society's

Raja Lakhamagouda Science Institute (Autonomous),

Belagavi.

Second Semester M.Sc. Degree Examination June - 2017

BP01: QUANTUM MECHANICS - I

Duration: 3 Hrs **Max Marks: 70**

Instructions to candidates:

Attempt any five questions including Q.No. 9, taking into account the internal options. Marks are shown on the right.

Important Note: 1. On completing answers, compulsorily draw diagonal lines on the remaining blank pages.
2. Any revealing of identification, appeal to valuator and / or equations written will be treated as malpractice.

1. a) State any five basic postulates of quantum mechanics.

b) Explain the principle of superposition.

c) Explain the operator forms for momentum, energy and Hamiltonian. **(5+4+6)**

OR

2. a) Discuss Eigen values and Eigen functions of a free particle.

b) Discuss the leakage of a free particle, travelling along x-axis through a rectangular potential barrier. Derive expressions for the transmission and reflection coefficients. **(5+10)**

3. a) Explain the parity operator.

b) Express the Hamiltonian of hydrogen- like atom in terms of centre-of-mass and relative coordinates. **(5+10)**

OR

4. Obtain the eigen values and eigen functions of L^2 and L_z in spherical polar coordinates. **(15)**

5. a) Develop the stationary perturbation theory up to first order for a system with non-degenerate states.

b) Work out the first order correction to the energy of the ground state of He atom **(10 +5)**

OR

6. a) Discuss the transition from one discrete level to another and obtain the expression for transition probability

b) Explain the transition to Continuum States **(10+5)**

7. a) Explain the Born approximation method for obtaining scattering cross sections.

b) Obtain scattering cross section for a shielded Coulomb potential by the Born approximation method **(9+6)**

OR

8. a) Explain partial waves analysis of scattering

b) Discuss the theory of partial wave scattering by central potential and show that scattering amplitude has contributions from all the partial waves. **(4+11)**

9. Solve any two of the following. **(5x2=10)**

a) A particle is described by the wave function $\psi(x) = \sqrt{a}\,x$ between x=0 and x=3, and zero elsewhere, find 'a' and ‹x›. Calculate the probability of finding the particle between x_1=0.5 and x_2=1

b) Given the radial wave function, $R_{10}(r)=\left(2/a_0{}^{2/3}\right)\exp(-r/a_0)$, where a_0 is Bohr radius for hydrogen atom ground state, calculate the radial distance where the radial probability density, $r^2|\,R_{10}(r)|^2$, is maximum.

c) A hydrogen atom in the 2p state is placed in a cavity. Find the temperature of the cavity at which the transition probabilities for stimulated and spontaneous emissions are equal.

d) A beam of particles is incident normally on a thin metal foil of thickness t. If N_0 is the number of nuclei per unit volume of the foil, show that the fraction of incident particles scattered in the direction (θ, φ) is $\sigma(\theta, \varphi)\, N_0 t\, d\Omega$, where $d\Omega$ is the solid angle in the direction (θ, φ).

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Second Semester M.Sc. Degree Examination June – 2017

BP02: ATOMIC, MOLECULAR AND OPTICAL PHYSICS

Duration: 3 Hrs **Max Marks: 70**

Instructions to candidates:

Attempt any five questions including Q. No. 9, taking into account the internal options. Marks are shown on the right.

1. Derive the expressions for the term values for the interaction energies in L-S coupling in case of alkaline elements. Explain also the p-d system. **[10+5]**

OR

2. Explain the splitting of spectral lines in the presence of weak magnetic field in alkali elements. How far apart are the Zeeman components of a line of 450 nm placed in a magnetic field of 0.3 T. (Given $\frac{e}{m} = 1.75882\ x\ 10^{11} Ckg^{-1}$) **[10+5]**

3. Explain CO_2 laser in detail with neat energy level diagrams. **[15]**

OR

4. **a)** Derive Schawlow - Townes condition for laser oscillations.
   b) Explain Doppler broadening of spectral lines. **[8+7]**

5. Without ignoring the interaction between the vibrational and rotational energies, discuss diatomic molecules as vibrating rotator. **[15]**

OR

6. Discuss various branches of the spectrum of diatomic molecules as nonrigid rotator and anharmonic oscillator. **[15]**

7. **a)** Explain F-C principle
   b) Discuss rotational fine structure of electronic vibrational transitions. **[5+10]**

OR

8. Write notes on:
   a) Pure rotational Raman spectra
   b) Fortrat's diagram **[8+7]**

9. Write notes on any two : **[5+5]**
   a) Salient features of atomic spectra
   b) Laser applications
   c) Spectrum of prolate type molecule
   d) Vibration coarse structure

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Second Semester M.Sc. Degree Examination June – 2017

BP03: NUCLEAR PHYSICS (GENERAL)

Duration: 3 Hrs **Max Marks: 70**

Instructions to candidates:

Attempt any five questions including Q. No. 9, taking into account the internal options. Marks are shown on the right.

Important Note: 1. On completing answers, compulsorily draw diagonal lines on the remaining blank pages.
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1. a) Explain the terms of Mirror nuclei and nuclear binding energy. Obtain expression nuclear radius by α- scattering.

b) Calculate the binding energy of an α particle and express the results both in Mev. Mass of proton =1.007276 u, Mass of neutron = 1.008665 u, Mass of the α – particle = 4.0015064 u. **[9+6]**

OR

2. a) Explain the experiernental determination of magnetic moment by Rabis atomic beam method.

b) Explain the terms of spin by hyperfine structure in detail. **[8+7]**

3. a) Explain in detail of weizsacker's semi empirical mass formula.

b) Explain in detail neutrino hypothesis. **[9+6]**

OR

4. a) Explain the Gamow's theory of alphadecay and establish the relation between the mean life lime and decay constant.

b) What is Gamma transition in nuclei and discuss classification. **[9+6]**

5. a) What is a nuclear reactor? Explain the fast breeder reactor.

b) Discuss the classification of elementary partides and explain quark model.

OR **[7+8]**

6. a) What is compound nucleus model?

b) Explain 'Q' value of out going particle of nuclear reaction.

c) Calculate the **Q-** Value of a reaction.

$^{12}C\ (\alpha, {}^{3}H_e)^{13}C$

Given: Mass of ^{12}C = 12 amu, mass of ^{13}C=13.003354 amu.

Mass of α = 4.002603 amu, mass of $({}^{3}H_e)$= 3.016029 amu **[5+6+4]**

7. **a)** Explain in detail of NaI(TI) scintillation Gamma ray spectrometer.

   b) Explain the terms in details.

   i) Photo electric effect

   ii) Compton effect **[7+8]**

OR

8. **a)** Explain the interaction heavy charged particles with matter and obtain expression for stopping power.

   b) Explain the Mossbauer Effect its application. **[9+6]**

9. **Answer any TWO of the following:** **[5x2=10]**

   a) Explain four factor formulas.

   b) Write a note on G. M. Counter.

   c) Discuss Fermi's theory of beta decay.

   d) Calculate the separation energy of neutron of O^{17}

   Given: $M(0^{17}) = 16.999131$ amu

   $M(0^{16}) = 16.994915$ amu

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Second Semester M.Sc. Degree Examination June - 2017

BP04: PROBABILITY THEORY

Duration: 3 Hrs **Max Marks: 70**

Instructions to candidates:

Attempt any five questions including Q.No. 9, taking into account the internal options. Marks are shown on the right.

Important Note: 1. On completing answers, compulsorily draw diagonal lines on the remaining blank pages.
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1. a) What do you mean by measures of central tendency? What are essentials of an ideal measures of central tendency?

b) If AM of two nos is 13 and their GM is 12. Find HM and nos.

OR **[7+8]**

2. a) Find mean and variance of the first 'n' natural nos.

b) What is dispersion? Write down the various measures of dispersion.

c) Define coefficient of variation. How it is used to compare two sets of data.

[8+3+4]

3. a) State and prove the properties of correlation coefficient.

b) In a bivariate data on x and y the means are 15 and 27 standard deviations are 5 and 3 resply. The coefficient correlation is -- 0.3. then what would be the expected value of y when x=8. **[10+5]**

OR

4. a) Explain the methods of studying correlation coefficients.

b) In a Binomial distribution the mean is 6 and the variance is 1.5. Then find P[x=2]

[10+5]

5. a) Define probability of an event. Then show that

i) $P(\bar{A})=1-P(A)$ **ii)** $0 \leq P(A) \leq 1$ **iii)** $P(\emptyset)=0$

b) Stat and prove addition theorem of expectation. **[10+5]**

OR

6. a) Derive probability mass function of Poisson distribution under what conditions Poisson distribution takes place.

b) Find even ordered centrat moment of Normal distribution. **[8+7]**

7. **a)** Explain the general procedure of testing of hypothesis.

b) It is required to test whether the proportion of smokes among students is less than that among the lectures. Among 60 randomly picked students 2 were smokers. Among 17 randomly picked lecturers 5 were smokers what would be your conclusion? **[10+5]**

OR

8. **a)** Define. **i)** Types of sampling

ii) Sampling distribution

iii) Standard error

iv) Critical region

b) Mean life of electric bulbs manufactured by a firm is 1200hrs. The standard deviation is 200 hrs. In a lot of 10,000 bulbs, how many bulbs are expected to have life 1050 hrs or more? **[7+8]**

9. **Answer any TWO of the following:** **[5x2=10]**

a) Principle steps in framing questionnaire.

b) Rules in construction of frequency distribution.

c) Skewness and types of skewness.

d) Properties of regression coefficients.

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