Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple.-(One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 Admission Onwards)
PHYSICS
PHY 4E08 : Electronic Instrumentation

Time : 3 Hours　　　　　　　　　　　　　　　　　　　　　　　　Max. Marks : 60

PART – A

Answer **both** questions (**a** or **b**). **Each** question carries **twelve** marks.

1. a) Discuss the working of :
      i) electronic counters and
      ii) AC millivoltmeters

      OR

   b) Explain the working of :
      i) a heterodyne wave analyser and
      ii) various signal generators.

2. a) Explain how a Wheatstone's bridge is used to make strain measurements. Hence discuss
      i) half and
      ii) full bridge configurations.

      OR

   b) Give the basic characteristics of a measurement system. **(2×12=24)**

PART – B

Answer **any four** questions. **Each** question carries **nine** marks. (**1** mark for Part **a**, **3** marks for Part **b** and **5** marks for Part **c**)

3. a) What is a measurement ?

   b) What are the three essential aspects of any measurement problem ?

   c) List the eight golden rules to be followed in any measurement problem.

4. a) Briefly explain the features of a CRT.

   b) Explain frequency measurement technique with Lissajous figures.

   c) A CRO is set to a time base of 0.2 ms/div with a 10 div. amplitude. Sketch the display of the CRO with an input of a 2 MHz pulse with 40% duty cycle.

5. a) What is an electrical transducer ?

   b) Explain the working of a RVDT and VRT.

   c) A linear variable differential transformer has a stroke length of ±150mm and produces a resolution of 40 mV/mm when moved. Determine a) The core position from center when the output voltage is 3.75 volts, and b) The change in output voltage when the core is moved from + 80 mm to – 80 mm displacement.

6. a) What is a optical strain gauge ?

   b) Give the theory of operation of a resistance strain gauge.

   c) A resistance wire strain gauge is bonded to a steel structural member subjected to a stress of 200 M N/sq.m. The modulus of elasticity of steel is 200 G N/sq. m. The percentage change in the value of gauge resistance due to the applied stress is 0.01%. Find out the gauge factor.

7. a) What is gate triggering of a thyristor ?

   b) Plot thyristor voltage waveform during turn off.

   c) Discuss switching characteristics during turn off.

8. a) What is meant by MRI scan ?

   b) Briefly explain how a MRI scan is taken.

   c) Give the block diagram of a MRI scan unit.   **(4×9=36)**

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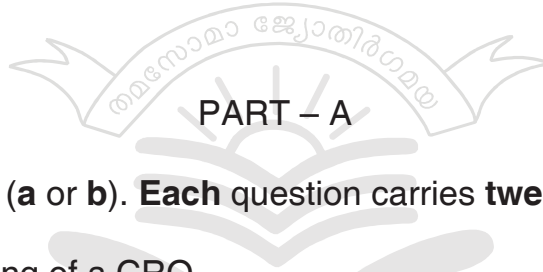**Name : ....**

IV Semester M.Sc. Degree (CBSS – Reg./ Supple./Imp.) Examination, April 2023
(2019 Admission Onwards)
PHYSICS
PHY4E08 : Electronic Instrumentation

Time : 3 Hours

Max. Marks : 60

PART – A

Answer **both** questions (**a** or **b**). **Each** question carries **twelve** marks.

1. a) Discuss the working of a CRO.

   OR

   b) Explain the working of (i) a lock-in amplifier and (ii) a frequency response analyser.

2. a) Explain how a Wheatstone's bridge is used to make strain measurements. Hence discuss (i) half and (ii) quarter bridge configurations.

   OR

   b) Give the basic characteristics of a measurement system.

   (2×12=24)

PART – B

Answer **any four** questions. **Each** question carries **nine** marks. (**1** mark for Part **a**, **3** marks for Part **b** and **5** marks for Part **c**.)

3. a) What is a measurement ?

   b) Give the block diagram of a generalised measurement system.

   c) Explain the various building blocks of a measurement system.

P.T.O.

4. a) Differentiate between a CRT and a CRO.

 b) Explain phase measurement technique with Lissajous figures.

 c) A CRO is set to a time base of 0.1 ms/div with a 10 div. amplitude. Sketch the display of the CRO with an input of a 2 MHz pulse with 60% duty cycle.

5. a) What is a transducer ?

 b) Explain the working of a LVDT.

 c) A linear variable differential transformer has a stroke length of ± 150 mm and produces a resolution of 40mV /mm when moved. Determine : a) The LVDT's maximum output voltage and b) The output voltage when the core is moved 120 mm from its null position.

6. a) What is a mechanical strain gauge ?

 b) Give the theory of operation of a resistance strain gauge.

 c) A resistance wire strain gauge with gauge factor 2 is bonded to a steel structural member subjected to a stress of 100 M N/sq. m. The modulus of elasticity of steel is 200 G N/sq. m. Calculate the percentage change in the value of gauge resistance due to the applied stress.

7. a) What is forward voltage triggering of a thyristor ?

 b) Plot thyristor voltage waveform during turn on.

 c) Discuss switching characteristics during turn on.

8. a) What is meant by CT scan ?

 b) Briefly explain how a CT scan is taken ?

 c) Give the block diagram of a CT scan unit.   **(4×9=36)**

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IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple.-(One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 Admission Onwards)
PHYSICS
PHY 4E06 : Optoelectronics

Time : 3 Hours
Max. Marks : 60

SECTION – A

Answer **both** the questions. (Either **a** or **b**).

1. a) Explain the theory of mode locking in lasers. Also describe one technique for mode locking.

    OR

   b) Explain the principle, working and basic structure of Avalanche photo diode. Also mention advantages of Avalanche photo diode over photodiode.

2. a) Explain the principle and working of acousto optic modulator.

    OR

   b) Explain the second and third order harmonic generations in an optically anisotropic medium. **(2×12=24)**

SECTION – B

Answer **any four** questions. (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**)

3. a) Define the efficiency of LED.

   b) Derive the expression for the efficiency of LED.

   c) Determine the wavelength of light emitted from LED which is made up of GaAsP semiconductor whose forbidden energy gap is 1.875 eV. Also mention the colour of the light emitted. Find the efficiency and power of the LED if the life times for radiative and non-radiative recombination respectively are 12 microseconds and 50 microseconds.

4. a) Describe the unstable resonators and its advantages.

   b) Explain the importance of Q switching.

   c) Explain any two methods of Q switching.

5. a) Define the term absorption coefficient.

   b) Describe the principle of photo conductive detector.

   c) Prove that there is an internal amplification of output current in a phototransistors.

6. a) Distinguish between direct and indirect band gap semiconductors.

   b) State and prove Ramos theorem.

   c) Discuss different types of noises in photodetectors.

7. a) Distinguish between transverse and longitudinal electro optic modulators.

   b) Explain Kerr effect.

   c) Explain the working of Faraday rotator.

8. a) What is the requirement of nonlinear material ?

   b) Explain two photon absorption.

   c) Describe temperature tuning and angle tuning.   **(4×9=36)**

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Name : ....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple.-(One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 Admission Onwards)
PHYSICS
PHY 4C15 : Numerical Techniques and Probability

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b**).

1. a) i) Derive Lagrange's interpolation formula for unequal intervals.

   ii) Obtain the Euler's Formula for the numerical solution of the differential equation. Why modified Euler's method is preferred over Euler's method.

   OR

   b) Obtain Newton-Cote's quadrature formula. Hence deduce Trapezoidal rule and Simpson's 1/3 rule.

2. a) Give an account of Chi-square distribution. Explain the probability density function of Chi-square distribution. Mention the applications of Chi-square distribution.

   OR

   b) i) Discuss the theorems of probability.

   ii) Briefly explain Regula falsi method for finding the real root of an equation. **(2×12=24)**

SECTION – B

Answer **any four** questions (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).

3. a) What is the order of convergence of the method of successive approximations ?

   b) What are the conditions for the validity of Chi-square test ?

   c) Find the first and second order differences for $f(x) = ab^{c\,x}$.

4. a) When will we use Newton's forward interpolation formula ?

   b) Find a cubic polynomial which takes the following values : y(1) = 24, y(3) = 120, y(5) = 336 and y(7) = 720.

   c) Use Lagrange's interpolation formula to fit a polynomial to the data and hence find the value of y when x = 2.

x	0	1	3	4
y	−12	0	6	12

5. a) What is binomial distribution ?

   b) Evaluate the probability of obtaining atleast 2550 heads in tossing a coin 5000 times using Normal distribution.

   c) On a production line, the probability that an item is faulty is 0.1. 50 items are chosen at random and checked for faults. Find the probability that there will be no faulty items and also the probability that there will be three faulty items using (i) binomial distribution and (ii) Poisson distribution.

6. a) Write the Runge Kutta second order formula.

   b) Solve $\dfrac{dy}{dx} = 1 - y$, y(0) = 0 by Euler's method. Find y at x = 0.1 and x = 0.2.

   c) Evaluate $\displaystyle\int_0^1 \dfrac{dx}{1+x}$, correct to three decimal places using h = 0.5 using Trapezoidal and Simpson 1/3 rule.

7. a) From a herd containing 5 Karan Fries and 4 Sahiwal cows, a cow is selected at random. What is the probability that it is a Sahiwal Cow ?

   b) Let X be a random variable with the probability distribution given below. Find the mean of X.

X	0	1	2	3
P(x)	$\frac{27}{64}$	$\frac{27}{64}$	$\frac{9}{64}$	$\frac{1}{64}$

   c) Two dice are rolled once. Find the probability that

      i) the numbers on the two dice are different.

      ii) the total is 7 or 9.

8. a) Give the formula for Newton-Raphson method.

   b) Give an account of iteration method for obtaining solutions of transcendental equations.

   c) Using Bisection method, find a positive real root of the equation $x \log_{10}x = 1.2$ in four iterations.　　　　　　　**(4×9=36)**

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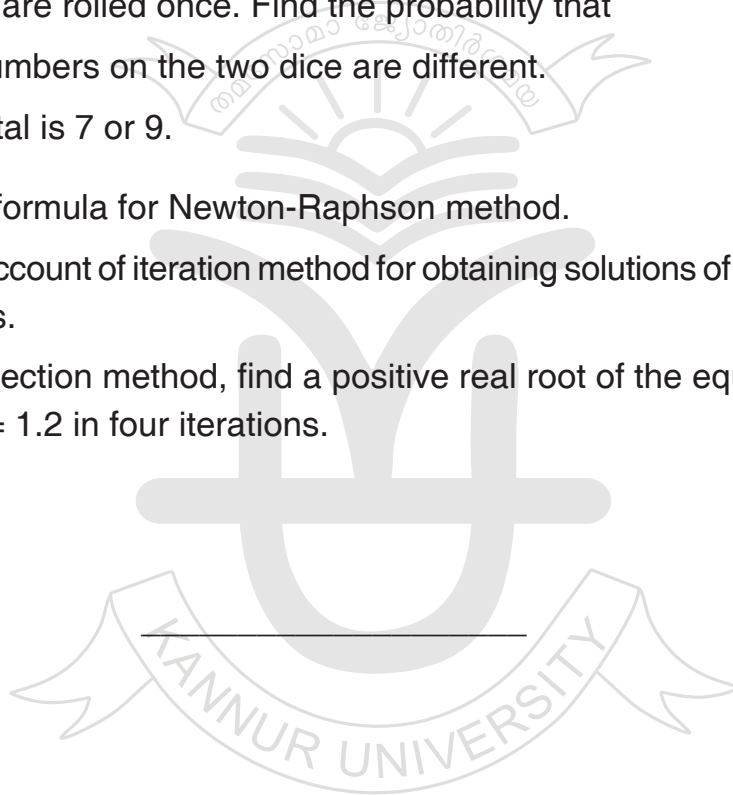
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Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (CBSS – Reg./Supple./Imp.) Examination, April 2023
(2019 Admission Onwards)
PHYSICS
PHY 4C15 : Numerical Techniques and Probability

Time : 3 Hours   Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b**).   **(2×12=24)**

1. a) Explain in detail the properties of binomial, poisson and normal distributions.

    OR

   b) Derive Newton's forward interpolation formula. Hence deduce Newton's backward interpolation formula.

2. a) i) Explain Simpson 3/8 rule.

      ii) Briefly explain Newton Raphson method for finding the real root of an equation.

    OR

   b) Explain the Milne's method for obtaining numerical solution of ordinary differential equations. Also explain Milne's correction.

SECTION – B

Answer **any four** questions (**one** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**).   **(4×9=36)**

3. a) If a letter is chosen at random from the English alphabet, find the probability that the letter is a vowel.

   b) State and explain the addition theorem of probability.

   c) Two identical boxes contain respectively 4 white and 3 red balls, and 3 white and 7 red balls. A box is chosen at random and a ball is drawn from it. If the ball is white, what is the probability that it is from the first box ?

P.T.O.

4. a) What is Poisson Distribution ?

   b) The mean and variance of a binomial random variable x are 16 and 8 respectively. Find $P(x = 0)$ and $P(x = 1)$.

   c) The weekly wages of 1000 workmen are normally distributed about a mean of Rs. 500 with a standard deviation of 50. Estimate the number of workers whose weekly wages will be (i) between Rs. 400 and Rs. 600 (ii) less than Rs. 400.

5. a) Write the Lagrange's Interpolation formula.

   b) Form a forward difference table for the following data.

x	0	1	2	3	4
y	8	11	9	15	6

   c) Determine the constants a and b by the method of least squares such that $y = ae^{bx}$ fits the following data.

x	2	4	6	8	10
y	4.077	11.084	30.128	81.897	222.62

6. a) What is Chi-square test ?

   b) What are the conditions for the validity of Chi-square test ?

   c) The number of automobile accidents per week in a certain community are as follows :

   12, 8, 20, 2, 14, 10, 15, 6, 9, 4. Calculate the value of Chi-square.

7. a) What are transcendental equations?

   b) Give an account of iteration method for obtaining solutions of transcendental equations.

   c) Using Newton Raphson method, find a real root of the equation $x^3 - 3x + 1 = 0$ lying between 1 and 2 correct to three decimal places.

8. a) Write the Runge Kutta second order formula.

   b) Evaluate $\int_0^1 \dfrac{dx}{1+x^2}$ using Trapezoidal rule with $h = 0.2$. Hence determine the value of π.

   c) Using Modified Euler's method, solve $\dfrac{dy}{dx} = 1 + xy$ with $y(0) = 2$. Find $y(0.2)$.

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Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.) Examination, April 2022
(2018 Admission Onwards)
PHYSICS
PHY – 4C15 : Numerical Techniques and Probability

Time : 3 Hours   Max. Marks : 60

SECTION – A

Answer both questions, either **(a)** or **(b)**. **Each** question carries **12** marks.

1. a) Define normal distribution and standard normal distribution. Write important properties of standard normal distribution. What is the relation between normal distribution and binomial distribution.

   OR

   b) Write a note on chi-square distribution and important properties of chi-square distribution. Also explain the method of chi-square test for goodness of fit.

2. a) Derive Newton's backward interpolation formula for equal intervals. Using Newton's backward interpolation formula, find the value of y(2.65) from the following data.

x	−1	0	1	2	3
y	−21	6	15	12	3

   OR

   b) Derive formula for Simpson's one third rule of the numerical integration of $\int_a^b f(x)\, dx$. Also discuss the error in Trapezoidal rule.   **(2×12=24)**

SECTION – B

Answer **any four** (**1** mark for part **'a'**, **3** marks for part **'b'**, **5** marks for part **'c'**).

3. a) State addition theorem for probability.

   b) From a pack of 52 cards, two cards are drawn the first being replaced before the second is drawn. Find the probability that the first one is a diamond and second is a king.

   c) State and prove Baye's theorem on probability.

P.T.O.

4. a) Define Poisson distribution.

 b) In a normal distribution 31% of the items are under 45 and 8% are over 64. Find the mean and standard deviation of the distribution.

 c) Fit a binomial distribution to the following data :

x	0	1	2	3	4	5
f	12	56	74	39	18	1

5. a) Write the name of two methods to find the root of a transcendental equation.

 b) Explain the geometric interpretation of Newton-Raphson method.

 c) Using bisection method, find a real root of the equation $x^3 - x - 11 = 0$.

6. a) What do you mean by forward difference operator ?

 b) Find the first and second order differences for $f(x) = ab^{cx}$.

 c) Find the function whose first difference is $x^3 + 3x^2 + 5x + 12$.

7. a) What is the order of error in Trapezoidal rule for numerical integration ?

 b) Evaluate $\int_0^1 \dfrac{dx}{1+x^2}$ by two point Gaussian quadrature formula and hence find the value of π.

 c) Evaluate $\int_0^{10} \dfrac{dx}{1+x^2}$ by using Trapezoidal rule.

8. a) Write Euler's modified formula to find the value of $y(x_1)$ from the differential equation $\dfrac{dy}{dx} = f(x, y), y(x_0) = y_0$.

 b) Using Euler's modified method, find the value of y at x = 0.1, given that $\dfrac{dy}{dx} = 1 + xy, y(0) = 2$.

 c) Compute $y(0.1)$ by Runge-Kutta method of 4th order for the differential equation $\dfrac{dy}{dx} = \dfrac{1}{x+y}, y(0) = 1$.   **(4×9=36)**

Reg. No. : ....

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IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple.-(One Time Mercy Chance)/Imp.) Examination, April 2024
(2014 Admission Onwards)
PHYSICS
PHY 4C14 : Optics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** the questions. (Either **a or b**).

1. a) i) Differentiate the principles of intrinsic and doped semiconductor lasers.
   ii) Obtain the theoretical condition for lasing action in semiconductor lasers.

   OR

   b) Describe the electro-optic effects. Explain how are they utilized for the enhancement of power of lasers.

2. a) Describe the nonlinear optical processes in crystals. Explain the physical processes of SHG, SFG, DFG and OR.

   OR

   b) Detail the possible signal distortions in optical wave guides.   **(2×12=24)**

SECTION – B

Answer **any four** questions. (**One** mark for Part **a**, **3** marks for Part **b**, **5** marks for Part **c**)

3. a) What is quantum coherence correlation function ?

   b) What is the role of He in He-Ne laser ?

   c) Prove that a two-level system is not suitable for optical pumping.

4. a) Briefly explain semi-classical theory of lasers.

   b) What is the acceptance angle and numerical aperture for a fiber with refractive indices $n_1 = 1.48$ and $n_2 = 1.45$?

   c) Describe the Q-factor of resonance cavities of lasers.

5. a) What is Faraday's magneto-optic effect ?

   b) Explain the tensor properties of optical susceptibility.

   c) How does sum frequency generation occur in nonlinear materials ?

6. a) Write a note on the variation of refractive index with intensity of light.

   b) How are second harmonics generated in nonlinear media ?

   c) Explain the basis of intensity dependence on the refractive index of materials.

7. a) What is Coherent Antistokes Raman Scattering ?

   b) Explain the principle of Stimulated Raman Gain Spectroscopy.

   c) What are Type I and Type II phase matching ?

8. a) Explain the pulse broadening in optical fibers.

   b) Deduce the acceptance angle and numerical aperture of an optical fiber.

   c) What is the basis of optical fiber amplifiers ?   (4×9=36)

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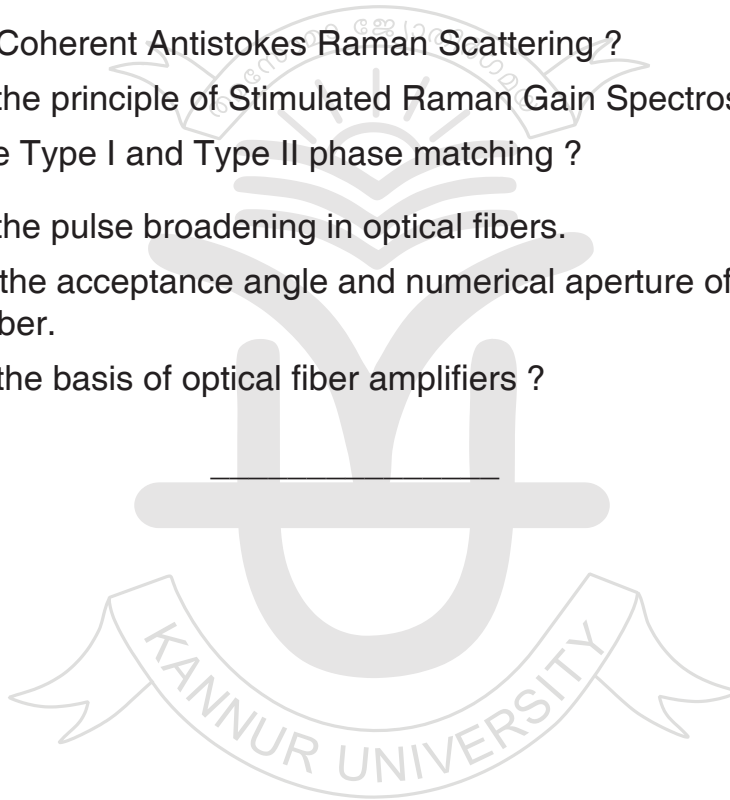
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Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (C.B.S.S. – Reg./Supple./Imp.) Examination, April 2023
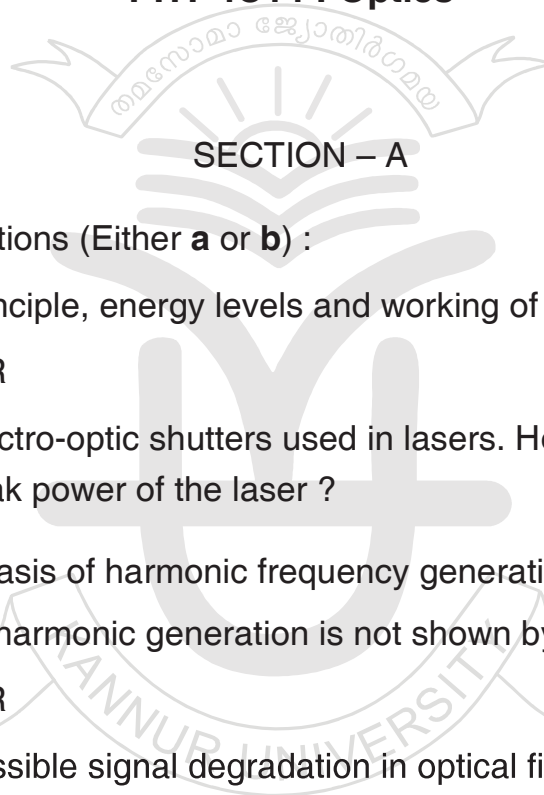### (2019 Admission Onwards)
PHYSICS
PHY 4C14 : Optics

Time : 3 Hours

Max. Marks : 60

SECTION – A

Answer **both** the questions (Either **a** or **b**) :

1. a) Describe the principle, energy levels and working of CO_2 molecular laser.

   OR

   b) Describe the electro-optic shutters used in lasers. How does it help to enhance the peak power of the laser ?

2. a) i) Explain the basis of harmonic frequency generation in crystals.

   ii) Why second harmonic generation is not shown by isotropic media ?

   OR

   b) Describe the possible signal degradation in optical fibers.   **(2×12=24)**

SECTION – B

Answer **any four** questions (**One** mark for part **a**, **three** marks for part **b**, **five** marks for part **c**).

3. a) Distinguish between spatial and temporal coherence.

   b) Write and explain the rate equation for the relation of a two-level atomic system.

   c) Obtain the expression for Peak power emitted by a Q-switched laser.

P.T.O.

4. a) What do you mean by light amplification ? Does it violate conservation of energy ?

   b) Describe the self-focusing of intense light beams as a non-linear phenomenon.

   c) Explain any method for single atom detection using dye lasers.

5. a) What is magneto optic effect ?

   b) Obtain the expression for the coherence length for second harmonic generation in a crystal.

   c) Describe the phenomenon parametric generation of light.

6. a) What is meant by optical rectification ?

   b) Describe stimulated Raman scattering.

   c) What are spatial solitons ?

7. a) What is the reason for opting graded index fiber to step index fiber for multimode transmission ?

   b) A 1 mW laser is focussed by a lens to a spot of 6 µm radius. Calculate the intensity and electric field at the spot.

   c) Describe the transmission characteristics of optical fibers.

8. a) What is meant by pulse broadening in optical fibers ?

   b) Explain the intermodal dispersion in optical fibers.

   c) You need to transmit data over an optical link of 100 km with fiber loss of 0.2 dB/km. The link has five splices with 0.05 dB loss per splice and two connectors with loss 0.2 dB per connector. If the receiver sensitivity is 20µW, what is the minimum transmitter power in both mW and dBm ?   **(4×9=36)**

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Reg. No. : ....

Name : ....

IV Semester M.Sc. Degree (CBSS – Reg./Supple./Imp.) Examination, April 2022
(2018 Admission Onwards)
PHYSICS
PHY 4C14 : Optics

Time : 3 Hours | Max. Marks : 60

SECTION – A

Answer both questions (either **a** or **b**) :

1. a) Describe the Laser rate equations for three level laser and four level laser systems.

    OR

   b) With an energy level diagram, explain the principle and working of a Ruby laser.

2. a) i) Explain the harmonic generation. How is second harmonic achieved ?

    ii) With the help of a diagram, describe the sum frequency and difference frequency generation.

    OR

   b) i) Give an account of bending losses in optical fibres.

    ii) Explain the power launching in optical fibres. **(2×12=24)**

SECTION – B

Answer **any four** (**1** mark for part **a**, **3** marks for part **b**, **5** marks for part **c**)

3. a) What is meant by spatial coherence ?

   b) What is meant by pumping ? Name five different methods.

   c) A laser beam of wavelength 740 nm has coherence time 4×10^{-5} s. Deduce the order of magnitude of its coherence length and spectral half width.

P.T.O.

4. a) What is meant by spectral hole burning ?

   b) Briefly explain the principle and operation of a optical resonator.

   c) At what temperatures are the rates of spontaneous and stimulated emission equal ? Assume, $\lambda = 5000$Å.

5. a) What is meant by Faraday effect ?

   b) Explain type I and type II phase matching.

   c) Sketch and explain electro-optic amplitude modulator using KDP crystals.

6. a) What is fiber birefringence ?

   b) Give an account of index ellipsoid of KDP crystals.

   c) Optical fibre amplifier as next generation lasers. Explain.

7. a) What are spatial solitons ?

   b) Briefly explain stimulated Raman scattering.

   c) A multimode step-index fiber has a relative refractive index difference of 2% and a core refractive index of 1.5. The number of modes propagating at a wavelength of 1.3 μm is 1000. Calculate the diameter of the fiber core.

8. a) What is meant by optical susceptibility tensor ?

   b) Briefly explain the third harmonic generation.

   c) What is meant by dispersion in optical fibres ? Distinguish between intramodal and intermodal dispersion. **(4×9=36)**