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SESSIONAL EXAMINATION-I
ODD SEM, 2023-2024

Branch: School of Engineering and Technology		Batch: 2023, Sem: 1st	23PH1001
Course Title	Modern Computational Physics	Course Code:	40
ID. No. of Student	2 3 1 1 9 8 1 1 0 5	Max. Marks	90 Minutes
		Max Duration	

Instructions:

- ***Attempt questions in order.***
- ***Students not to write anything on question paper.***
- ***Use of calculator allowed.***

Course Learning Outcomes:

CLO-1	Apply the knowledge of gradient, divergence, curl and Maxwell's equations to understand the propagatio waves
CLO-2	Apply the principles of lasers and optical fibres to solve practical problems in engineering
CLO-3	Analyze scientific measurements related to magnetic materials and superconductivity for engineering ap
CLO-4	Apply fundamental concepts of physics to suggest appropriate solutions to practical engineering problen
CLO-5	Probe the physics behind microscopic systems using concepts of quantum mechanics and gaming science.

SECTION – A

(All Questions are Compulsory. Each question carries 01 mark) ***(5x1=5)***

For a solenoidal vector field **F**

1. (i) Divergence of **F** is zero (ii) Curl of **F** is zero
   (iii) Gradient of **F** is zero (iv) None of the above

If **E** and **B** are electric and magnetic fields, Maxwell's equation $\nabla \times \boldsymbol{H} = \boldsymbol{J} + \frac{\partial \boldsymbol{D}}{\partial t}$ represents

2. (i) Coulombs's law of electrostatics (ii) Gauss's Law of magnetostatics
   (iii) Modified Ampere's circuital law (iv) Faraday's law of EMI

An electron undergoes a transition between two energy states E_1 and E_2 if

3. (i) $E_2 - E_1 > h\nu$ (ii) $E_1 - E_2 = h\nu$
   (iii) $E_2 - E_1 < h\nu$ (iv) $E_2 - E_1 = h\nu$

The metastable state does not exist in a

4. (i) 3 level laser (ii) 4 level laser
   (iii) 2 level laser (iv) 5 level laser

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5. Surface integral is converted into line integral by using
(i) Gauss's divergence theorem
(ii) Green's theorem
(iii) Stoke's theorem
(iv) (ii) & (iii)

SECTION – B

(Attempt any 5 questions, each question carries 02 marks) (5x2=10)

6. Determine the curl of a vector $\vec{r} = xy\,\hat{i} + yz\,\hat{j} + zx\,\hat{k}$. CL
7. State Stoke's theorem and give its mathematical expression. CL
8. Distinguish between vector and scalar fields. CL
9. Draw the energy level diagram of a three-level laser system. CL
10. Distinguish between spontaneous and stimulated emissions. CL
11. How population inversion is important for LASER action? CL

SECTION – C

(Attempt any 3 questions, each question carries 5 marks) (3x5=15)

12. Give physical significance of the gradient of a scalar function with a suitable example in electrodynamics. CL
13. Find the value of '*a*' if the vector function is $\vec{A} = (x + 3y)\,\hat{i} + (2y + 3z)\,\hat{j} + (x + az)\,\hat{k}$ is solenoidal. CL
14. Explain the working of a four-level LASER system using energy level diagram. CL
15. Discuss various characteristics of a LASER beam. CL

SECTION – D

(Attempt any one question, each question carries 10 marks, subparts (if any) carry equal weightage)

16. Derive integral forms of Maxwell's equations from differential forms and discuss their physical meaning.
17. Explain the construction and working of the Ruby laser using a suitable energy diagram. Discuss its advantages and disadvantages.

* ① Divergence = 0
② $\nabla \cdot A = 0$ = sol
* curl = 0
$\nabla \times \vec{A}$ = irrot

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SESSIONAL EXAMINATION-II
ODD SEM, 2023-2024

...ch: Computer Science and Engineering	Batch: 2023, Sem: I
...se Title: Modern and Computational Physics	Course Code: 23PH001
...No. of Student: 3 1 1 9 8 1 1 0 5	Max. Marks: 40
	Max Duration: 90 Minutes

Instructions:

- ***Attempt questions in order.***
- ***Students not to write anything on question paper.***
- ***Use of calculator is allowed.***

Course Learning Outcomes:

CLO-1	Apply the knowledge of gradient, divergence, curl and Maxwell's equations to understand the propagation of radio waves
CLO-2	Apply the principles of lasers and optical fibres to solve practical problems in engineering
CLO-3	Analyze scientific measurements related to magnetic materials and superconductivity for engineering applications
CLO-4	Apply fundamental concepts of physics to suggest appropriate solutions to practical engineering problems
CLO-5	Probe the physics behind microscopic systems using concepts of quantum mechanics and gaming science.

SECTION – A

(All Questions are Compulsory. Each question carries 01 mark) **(5x1=5)**

The numerical aperture of an optical fibre is defined as

1. (i) sine of the acceptance angle (ii) cosine of the acceptance angle
   (iii) tangent of the acceptance angle (iv) cotangent

The innermost part of the optical fibre is called

2. (i) core (ii) jacket
   (iii) cladding (iv) shield

The magnetic susceptibility of paramagnetic materials is

3. (i) positive (ii) negative
   (iii) zero (iv) infinite

Which of the following parts of optical fibre has a greater refractive index

4. (i) core (ii) jacket
   (iii) cladding (iv) shield

Temperature at which normal materials turn into superconducting state is called the

5. (i) critical temperature (ii) Curie temperture
   (iii) transition temperature (iv) Absolute temperature

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[Total No. of Pa...rk)

SECTION – B

(Attempt any 5 questions, each question carries 02 marks) (5x2=10)

6. Show the process of signal propagation through an optical fibre with the help of a diagram. **CLO-2**
7. Distinguish between step index and graded index multimode fibres. **CLO-2**
8. List down various applications of optical fibres in engineering and technology. **CLO-2**
9. Differentiate between soft and hard magnetic materials. **CLO-3**
10. Discuss isotope effect with the help of suitable mathematical expression. **CLO-3**
11. Show on the basis of Meissner effect that superconductors are diamagnetic materials. **CLO-3**

SECTION – C

(Attempt any 3 questions, each question carries 5 marks) (3x5=15)

12. Determine the acceptance angle and numerical aperture of an optical fibre for which the core and cladding refractive indices are 1.61 and 1.59, respectively. **CLO-2**
13. A light signal of wavelength 800 nm propagates through an optical fibre of core diameter 30μm, whose core and cladding refractive indices are 1.60 and 1.55, respectively. Calculate the number of modes and normalized frequency. **CLO-2**
14. Give the characteristics of ferromagnetic materials. Why they are used in the production of permanent magnets? **CLO-3**
15. A material of magnetic susceptibility -4×10^{-5} is placed in an external magnetic field strength of 12 Am^{-1}. Calculate (i) the intensity of magnetization and (ii) magnetic flux density. The permeability of free space (μ_0) is $4\pi \times 10^{-7}$ N/A^2. **CLO-3**

SECTION – D

(Attempt any one question, each question carries 10 marks, and subparts (if any) carry equal weightage) (1x10=10)

16. A light signal is launched into the core of an optical fibre for which core and cladding refractive indices are μ_1 and μ_2, respectively. Derive the expressions for the acceptance angle and numerical aperture of this optical fibre if the signal enters the fibre from a medium of refractive index $\mu_0 = 0$. **CLO-2**
17. Distinguish among diamagnetic, paramagnetic and ferromagnetic materials. Show the hysteresis behaviour of ferromagnetic materials on the basis of the hysteresis loop. **CLO-3**

DO NOT

END TERM EXAMINATIONS
ODD SEM, AY: 2023-2024

Branch	SOET	Batch: 2023, Semester: I	
Code	23PH001/PH121	Course Title	Modern and Computational Physics
No. of Student	3 1 1 9 8 1 1 6 5	Max. Marks	60
		Max Duration	3 Hours

Instructions:

- *Attempt questions in order.*
- *Students not to write anything on question paper.*
- *Use of calculator is allowed.*

Course Learning Outcomes:

CLO-1	Apply the knowledge of gradient, divergence, curl and Maxwell's equations to understand propagation of radio waves.
CLO-2	Apply the principles of lasers and optical fibres to solve practical problems in engineering
CLO-3	Analyze scientific measurements related to magnetic materials and superconductivity for engineering applications
CLO-4	Apply fundamental concepts of physics to suggest appropriate solutions to practical engineering problems
CLO-5	Probe the physics behind microscopic systems using concepts of quantum mechanics and gaming science.

SECTION – A

(Questions 1 to 5 has four choices, out of which only one is correct, no negative marking for incorrect answer, each question carries 01 mark) (5x1=5)

1. Stoke's theorem converts

   a) Surface integral into volume integral
   b) Surface integral into line integral
   c) Line integral into volume integral
   d) Volume integral into line integral

2. Which of the following phenomena is employed in optical fibres for signal propagation?

   a) Diffraction
   b) Interference
   c) Refraction
   d) Total internal reflection

3. Bohr magnetron is the unit of

   a) Magnetic moment
   b) Angular momentum
   c) Energy
   d) Linear momentum

4. Temperature below which a normal conductor turns into superconductors is called

   a) Curie temperature
   b) Critical temperature
   c) Threshold temperature
   d) Absolute temperature

5. The entire information about a quantum mechanical system is contained in

   a) Wave function
   b) Position
   c) Operator
   d) Eigen value

SECTION – B

(Attempt any 5 questions, each question carries 02 marks) (5x2=10)

6. Give the statement and mathematical expression of Gauss's divergence theorem. CLO-1

7. Give physical significance of gradient of a scalar function. CLO-1

8. Show that superconductors are diamagnetic materials. CLO-3

9. Does critical temperature of superconductors vary with change in isotopic masses? Explain with the help of isotope effect. CLO-3

10. Distinguish between phase and group velocity. CLO-5

11. A diamagnetic material of magnetic susceptibility -4×10^{-5} is placed in an external magnetic field of 10^4 Am^{-1}. Calculate the intensity of magnetisation. CLO-4

SECTION – C

(Attempt any 5 question, each question carries 05 marks, subparts (if any) carry equal weightage) (5x5=25)

12. Find the constant 'a' for which a vector $\mathbf{A} = (x + 3y)\,\mathbf{i} + (2y + 3z)\,\mathbf{j} + (x + az)\,\mathbf{k}$ is solenoidal. CLO-1

13. Derive integral forms of Maxwell's equations from their differential forms. CLO-4

14. Discuss the hysteresis behaviour of ferromagnetic materials using a suitable diagram. CLO-3

15. Distinguish between a laser light and an ordinary light on the basis of coherence and monochromaticity? Is it possible to obtain perfectly monochromatic laser beam? CLO-2

16. How many modes are allowed to propagate through an optical fibre of core diameter of 40 μm if the core and cladding refractive indices are 1.461 and 1.456, respectively? Given that the wavelength of the signal is 850 nm. CLO-2

17. Draw a block diagram of a GPS system and discuss its working. CLO-4

SECTION – D

(Attempt any 2 question, each question carries 10 marks, subparts (if any) carry equal weightage) (2x10=20)

18. Discuss the functions of various components of a Ruby laser with the help of a diagram. Explain its working principle using a suitable energy level scheme. CLO-2

19. Consider an optical fibre whose core and cladding refractive indices are μ_1 and μ_2, respectively. Derive expressions for the acceptance angle and numerical aperture of this fibre if the signal is propagated into the core of this fibre from a medium of refractive index $\mu_0 = 0$ (say air). CLO-2

20. Derive time independent Schrodinger equation for a microscopic particle of mass m and total energy E if the particle is moving under the influence of a potential V. CLO-5

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SESSIONAL EXAMINATION-III
EVEN SEM, 2023-2024

Branch: Computer Science and Engineering		Batch: 2023, Sem: II	
Course Title	Modern and Computational Physics	Course Code	23PH001
ID. No. of Student		Max. Marks	40
2311981614		Max Duration	90 Minutes

Instructions:

- *Attempt questions in order.*
- *Students are not to write anything on the question paper.*
- *Use of scientific calculator is allowed.*

Course Learning Outcomes:

CLO-1	Apply the knowledge of gradient, divergence, curl and Maxwell's equations to understand the propagation of radio waves
CLO-2	Apply the principles of lasers and optical fibres to solve practical problems in engineering
CLO-3	Analyze scientific measurements related to magnetic materials and superconductivity for engineering applications
CLO-4	Apply fundamental concepts of physics to suggest appropriate solutions to practical engineering problems
CLO-5	Probe the physics behind microscopic systems using concepts of quantum mechanics and gaming science.

SECTION – A

(All Questions are Compulsory, Each question carries 01 mark) ***(5x1=5)***

1. The condition for an irrotational vector field is that its **CLO-1**
   (i) Curl vanishes (ii) Gradient vanishes
   (iii) Divergence vanishes (iv) Curl and divergence both vanish

2. Which of the following laws describes Maxwell's equation $\vec{\nabla}.\vec{D} = \rho$ **CLO-1**
   (i) Coulombs' law of electrostatics (ii) Gauss' Law of electrostatics
   (iii) Modified Ampere's circuital law (iv) Gauss' Law of magnetostatics

3. When an atom is exposed to radiation having a stream of photons each with energy hu, the following processes can take place **CLO-2**
   (i) Absorption (ii) Spontaneous emission
   (iii) Stimulated emission (iv) All of them

4. A mathematical representation of a quantum particle is described by a
   (i) Waveguide (ii) Wavefunction **CLO-5**
   (iii) Differential operator (iv) Partial derivative

5. In multimode optical fibre, the refractive index of the core varies with the
   (i) Radial distance (ii) Refractive index of the cladding **CLO-2**
   (iii) Medium of the propagation (iv) Acceptance angle

SECTION – B

(Attempt any 5 questions, each question carries 02 marks) **(5x2=10)**

6. State and explain the theorem that converts the surface integral into line integral in 2 dimension. **CLO-1**

7. Calculate $\vec{\nabla}.\vec{A}$ if $\vec{A} = x^2y\,\hat{i} + y^2z\,\hat{j} + z^2x\,\hat{k}$. **CLO-1**

8. Interpret the physical significance of the gradient of a scalar field. **CLO-1**

9. Distinguish between the single mode and multimode optical fibre. **CLO-2**

10. Illustrate the relationship between temperature and isotopic m[ass of a superconductor with a suitable mathematical expression. **CLO-3**

11. Draw the energy level diagram of a four-level laser. **CLO-2**

SECTION – C

(Attempt any 3 questions, each question carries 5 marks) **(3x5=15)**

12. Derive the integral form of Maxwell's first and third equation from the differential form. **CLO-1**

13. The refractive indices of the core and cladding of an optical fibre are 1.46 and 1.42, respectively. Determine the numerical aperture and acceptance angle of this optical fibre. **CLO-2**

14. Describe the magnetic behaviour of the superconductors using the Meissner effect. **CLO-4**

15. Calculate the number of allowed modes and normalised frequency if a light signal of 800 nm wavelength is propagated through an optical fibre of core diameter 0.06 mm and the numerical aperture of the fibre is 0.24. **CLO-2**

SECTION – D

(Attempt any one question, each question carries 10 marks, subparts (if any) carry equal weightage) **(1x10=10)**

16. (a) Describe Engineering applications of magnetic materials and superconductors.
    (b) The critical temperature of a superconducting material is 4.18°K when its atomic mass is 199.5. Calculate its critical temperature when its isotopic mass is 203.4°K. **CLO-3**

17. Derive a time-independent Schrodinger wave equation for a particle of mass m and total energy E moving under the influence of a potential field V. **CLO-5**