**Roll No. .....**

| Question Booklet Number |
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**O. M. R. Serial No.** | | | | | | | |

# M. Sc. (Fourth Semester)

# (NEP) EXAMINATION, 2025-26

## PHYSICS

## (Laser Physics And Applications) (Elective)

| Paper Code | | | | | | | |
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| B | 0 | 1 | 1 | 0 | 0 | 6 | T |

| Questions Booklet Series |
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| B |

*Time : 1:30 Hours* ] [ *Maximum Marks : 75*

**Instructions to the Examinee :**

1. Do not open the booklet unless you are asked to do so.

2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.

3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

**परीक्षार्थियों के लिए निर्देश :**

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।

2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।

3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

**(Remaining instructions on the last page)** **(शेष निर्देश अन्तिम पृष्ठ पर)**

*(Only for Rough Work)*

1. Laser cutting uses :

(A) High power density

(B) Low intensity

(C) No heat

(D) Reflection

2. Holography records :

(A) Intensity only

(B) Phase and amplitude

(C) Frequency

(D) Temperature

3. Laser communication uses :

(A) Optical carrier

(B) Radio only

(C) Sound

(D) Heat

4. LASIK surgery uses :

(A) $CO_2$ laser

(B) Excimer laser

(C) Ruby laser

(D) He-Ne laser

5. Range finding uses :

(A) Radar only

(B) Laser pulses

(C) Sound

(D) Heat

6. Military laser applications include :

(A) Target designation

(B) Cooking

(C) Cooling

(D) Painting

7. Laser cooling is based on the :

(A) Doppler effect

(B) Heating

(C) Reflection

(D) Pressure

8. Optical trapping uses :

(A) Radiation pressure

(B) Gravity

(C) Magnetism

(D) Heat

9. Infrared detectors detect :

(A) Visible light

(B) Infrared radiation

(C) Ultraviolet

(D) X-rays

10. Laser hazards mainly affect the :

(A) Eyes

(B) Hair

(C) Nails

(D) Bones

11. Barcode scanners use a :

(A) Laser diode

(B) $CO_2$ laser

(C) Ruby laser

(D) Dye laser

12. Optical fibre communication uses :

(A) LED or laser

(B) Heat waves

(C) Sound

(D) Radio only

13. Laser material processing includes :

(A) Welding

(B) Cutting

(C) Drilling

(D) All of the above

14. Medical photocoagulation uses :

(A) Laser heating

(B) Cooling

(C) Reflection

(D) Absorption only

15. Hologram reconstruction requires :

(A) Coherent light

(B) Incoherent light

(C) Heat

(D) Sound

16. Laser printers use a :

(A) Semiconductor laser

(B) Gas laser

(C) Dye laser

(D) Ruby laser

17. Optical tweezers trap :

(A) Atoms or particles

(B) Sound waves

(C) Heat

(D) Dust only

18. Laser spectroscopy studies :

(A) Energy levels

(B) Heat

(C) Density

(D) Pressure only

19. Infrared imaging is used in :

(A) Night vision

(B) Painting

(C) Cooking

(D) Writing

20. Laser safety requires :

(A) Protective goggles

(B) No care

(C) Heat shield only

(D) Darkness

21. Optical storage (CD/DVD) uses :

(A) Laser

(B) Heat

(C) Magnet

(D) Sound

22. Industrial alignment uses :

(A) Laser beam straightness

(B) Heat

(C) Sound

(D) Pressure

23. LIDAR uses :

(A) Laser pulses

(B) Radar waves

(C) Sound

(D) Heat

24. Laser angioplasty treats :

(A) Blocked arteries

(B) Bones

(C) Skin only

(D) Teeth

25. Optical communication bandwidth is :

(A) Very high

(B) Low

(C) Zero

(D) Constant

26. Optical fibre operates on the principle of :

(A) Reflection

(B) Total internal reflection

(C) Refraction only

(D) Diffraction

27. The refractive index of the fibre core is :

(A) Less than that of the cladding

(B) Greater than that of the cladding

(C) Equal to that of the cladding

(D) Zero

28. Numerical aperture represents the :

(A) Light-gathering ability of the fibre

(B) Heat capacity

(C) Pressure inside the fibre

(D) Material density

29. The core diameter of a single-mode fibre is :

(A) Large

(B) Very small

(C) Infinite

(D) Zero

30. Multimode fibre is mainly affected by :

(A) Modal dispersion

(B) No dispersion

(C) Heating

(D) Electrical noise

31. The unit of fibre attenuation is :

(A) dB/km

(B) W/m

(C) Hz

(D) Tesla

32. Optical fibre loss occurs due to :

(A) Absorption

(B) Scattering

(C) Bending

(D) All of the above

33. Maxwell's equations describe :

(A) Electromagnetic wave propagation

(B) Heat transfer

(C) Sound waves

(D) Gravitational force

34. A step-index fibre has :

(A) Uniform core refractive index

(B) Gradually varying refractive index

(C) Zero refractive index

(D) Variable cladding thickness

35. A graded-index fibre reduces :

(A) Modal dispersion

(B) Absorption loss

(C) Thermal effects

(D) External reflection

36. A common method for fibre fabrication is :

(A) Vapour deposition

(B) Casting

(C) Forging

(D) Rolling

37. The optical source used in fibre communication is :

(A) LED or laser diode

(B) Heater

(C) Electric motor

(D) Battery

38. A photodetector converts :

(A) Light into an electrical signal

(B) Heat into sound

(C) Sound into light

(D) Pressure into heat

39. Dispersion in optical fibre results in :

(A) Pulse broadening

(B) Cooling

(C) Heating

(D) Reflection

40. Fibre bandwidth is mainly limited by :

(A) Dispersion

(B) Colour of light

(C) Fibre shape

(D) Length only

41. Bending loss in a fibre increases when the :

(A) Radius of curvature decreases

(B) Radius of curvature increases

(C) Fibre is perfectly straight

(D) Temperature decreases

42. Optical repeaters are used for :

(A) Signal amplification

(B) Cooling

(C) Heating

(D) Reflection

43. The core of an optical fibre is generally made of :

(A) Silica

(B) Iron

(C) Copper

(D) Plastic only

44. The function of cladding in an optical fibre is :

(A) Confinement of light within the core

(B) Heating the fibre

(C) External reflection of light

(D) Decoration

45. An important advantage of optical fibre communication is :

(A) Low transmission loss

(B) High bandwidth

(C) Immunity to electromagnetic interference

(D) All of the above

46. Rayleigh scattering in optical fibres varies as :

(A) $1/\lambda^4$

(B) $\lambda$

(C) $\lambda^2$

(D) Constant

47. The main optical communication window is near :

(A) 1.55 μm

(B) 10 μm

(C) 0.1 μm

(D) 5 mm

48. Mode field diameter is associated with :

(A) Single-mode fibre

(B) Multimode fibre

(C) Gas laser

(D) Ruby laser

49. Fibre connectors are used to :

(A) Join two optical fibres

(B) Join metals

(C) Connect gas tubes

(D) Hold mirrors

50. Optical fibre communication is primarily used for :

(A) Internet and telecommunication

(B) Cooking

(C) Heating

(D) Painting

51. Population inversion is required for :

(A) Absorption

(B) Spontaneous emission

(C) Stimulated emission

(D) Reflection

52. The Einstein coefficient related to stimulated emission is :

(A) $A_{21}$

(B) $B_{12}$

(C) $B_{21}$

(D) $C_{21}$

53. In a three-level laser, pumping occurs from :

(A) Ground state to metastable state

(B) Ground state to excited state

(C) Metastable state to ground state

(D) Excited state to ground state

54. Which laser system is more efficient ?

(A) Two-level

(B) Three-level

(C) Four-level

(D) Single-level

55. Laser light is :

(A) Incoherent

(B) Monochromatic and coherent

(C) Highly divergent

(D) Random in phase

56. Mode locking produces :

(A) Continuous radiation

(B) High-power short pulses

(C) Low-frequency output

(D) Noise

57. Lamb dip is observed in :

(A) Saturated absorption spectroscopy

(B) Reflection

(C) Refraction

(D) Scattering

58. Hole burning occurs due to :

(A) Thermal effects

(B) Saturation at specific frequencies

(C) Reflection losses

(D) Pump failure

59. Laser action requires :

(A) Optical cavity

(B) Population inversion

(C) Gain medium

(D) All of the above

60. The linewidth of a laser is mainly due to :

(A) Doppler broadening

(B) Natural broadening

(C) Collisional broadening

(D) All of the above

61. The lifetime of a metastable state is typically :

(A) Very short

(B) Relatively long

(C) Zero

(D) Infinite

62. A photon produced by stimulated emission has :

(A) Random direction

(B) Same phase and direction

(C) Opposite energy

(D) Different wavelength

63. The threshold condition for lasing occurs when :

(A) Gain < loss

(B) Gain = loss

(C) Gain > loss

(D) Loss = 0

64. Q-switching in lasers refers to :

(A) Mechanical switching of mirrors

(B) Sudden release of stored energy producing a giant pulse

(C) Cooling of the gain medium

(D) Absorption of radiation

65. Coherence length depends on :

(A) Intensity

(B) Linewidth

(C) Temperature

(D) Mirror size

66. Photon energy is given by :

(A) $h\nu$

(B) $mc^2$

(C) $k$T

(D) $h\nu^2$

67. Doppler broadening is caused by :

(A) Motion of atoms or molecules

(B) Pressure

(C) Magnetic field

(D) Mirror losses

68. Natural broadening arises from :

(A) Heisenberg uncertainty principle

(B) Temperature

(C) Pressure

(D) Doppler effect

69. Laser beam divergence is :

(A) Large

(B) Very small

(C) Infinite

(D) Zero

70. Optical gain refers to :

(A) Loss of energy

(B) Amplification of light

(C) Absorption

(D) Reflection

71. Mode pulling refers to :

(A) Frequency shift toward the gain peak

(B) Mirror displacement

(C) Noise reduction

(D) Cooling

72. Q-switching produces :

(A) Continuous output

(B) Giant pulses

(C) Low-power radiation

(D) Noise

73. Laser rate equations describe ;

(A) Population dynamics of energy levels

(B) Mirror motion

(C) Cooling rate

(D) Scattering

74. Coherence describes the relationship of :

(A) Phase

(B) Temperature

(C) Pressure

(D) Density

75. The first laser demonstrated was :

(A) $CO_2$ laser

(B) Ruby laser

(C) He-Ne laser

(D) Nd :YAG laser

76. Ruby laser is a :

(A) Gas laser

(B) Solid-state laser

(C) Liquid laser

(D) Semiconductor laser

77. The active ion in a ruby laser is :

(A) $Fe^{3+}$

(B) $Cr^{3+}$

(C) $Nd^{3+}$

(D) $Cu^{2+}$

78. The wavelength of a He-Ne laser is :

(A) 632.8 nm

(B) 10.6 μm

(C) 1.06 μm

(D) 500 nm

79. A $CO_2$ laser emits in the :

(A) Ultraviolet region

(B) Visible region

(C) Infrared region

(D) Microwave region

80. Nd :YAG laser wavelength is :

(A) 0.53 μm

(B) 1.06 μm

(C) 10.6 μm

(D) 632 nm

81. A semiconductor laser is also known as a :

(A) Diode laser

(B) Gas laser

(C) Dye laser

(D) Solid rod laser

82. Dye lasers are :

(A) Tunable

(B) Fixed wavelength

(C) Low-power only

(D) UV only

83. Excimer lasers operate in the :

(A) Infrared

(B) Visible

(C) Ultraviolet

(D) Microwave

84. A laser resonator provides :

(A) Optical feedback

(B) Cooling

(C) Pumping.

(D) Absorption

85. Optical cavity mirrors are usually :

(A) Both transparent

(B) One fully reflecting and one partially reflecting

(C) Both absorbing

(D) None of the above

86. A laser amplifier increases :

(A) Frequency

(B) Intensity

(C) Wavelength

(D) Temperature

87. Pumping in a He-Ne laser is achieved by :

(A) Optical pumping

(B) Electrical discharge

(C) Chemical reaction

(D) Thermal excitation

88. $CO_2$ laser efficiency is :

(A) Very low

(B) Very high

(C) Zero

(D) Constant

89. Nd :YAG lasers are commonly used for :

(A) Surgery

(B) Cooling

(C) Imaging only

(D) Radio waves

90. Semiconductor lasers are widely used in :

(A) Optical fibre communication

(B) Heating only

(C) Microwaves

(D) Nuclear reactors

91. Population inversion in a ruby laser is :

(A) Easy

(B) Difficult

(C) Impossible

(D) Automatic

92. Gas lasers generally have :

(A) Narrow linewidth

(B) Broad linewidth

(C) No coherence

(D) No output

93. The medium of a dye laser is :

(A) Crystal

(B) Gas

(C) Liquid dye solution

(D) Semiconductor

94. The term "excimer" means :

(A) Excited dimer

(B) Ground atom

(C) Ion pair

(D) Molecular ion

95. Resonator stability depends mainly on :

(A) Mirror curvature

(B) Temperature

(C) Pump power

(D) Gas pressure only

96. Laser threshold depends on :

(A) Gain and loss

(B) Colour

(C) Shape

(D) Density only

97. Optical pumping uses :

(A) Light source

(B) Electric current

(C) Heat

(D) Pressure

98. Continuous-wave lasers emit :

(A) Pulses

(B) Steady beam

(C) Noise

(D) UV only

99. The host crystal of Nd :YAG is :

(A) Aluminium oxide

(B) Yttrium aluminium garnet

(C) Sodium chloride

(D) Silicon

100. Optical gain in a laser medium implies :

(A) Negative absorption

(B) Positive absorption

(C) Zero absorption

(D) Reflection

*(Only for Rough Work)*

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the correct answer and mark the same in the OMR Answer-Sheet as per the direction :

**Example :**

**Question :**

Q. 1 (A) ● (C) (D)
Q. 2 (A) (B) ● (D)
Q. 3 (A) ● (C) (D)

Illegible answers with cutting and over-writing or half filled circle will be cancelled.

5. Each question carries equal marks. Marks will be awarded according to the number of correct answers you have.

6. All answers are to be given on OMR Answer Sheet only. Answers given anywhere other than the place specified in the answer sheet will not be considered valid.

7. Before writing anything on the OMR Answer Sheet, all the instructions given in it should be read carefully.

8. After the completion of the examination candidates should leave the examination hall only after providing their OMR Answer Sheet to the invigilator. Candidate can carry their Question Booklet.

9. There will be no negative marking.

10. Rough work, if any, should be done on the blank pages provided for the purpose in the booklet.

11. To bring and use of log-book, calculator, pager and cellular phone in examination hall is prohibited.

12. In case of any difference found in English and Hindi version of the question, the English version of the question will be held authentic.

**Impt. :** On opening the question booklet, first check that all the pages of the question booklet are printed properly. If there is any discrepancy in the question Booklet, then after showing it to the invigilator, get another question Booklet of the same series.

4. प्रश्न-पुस्तिका में प्रत्येक प्रश्न के चार सम्भावित उत्तर—A, B, C एवं D हैं। परीक्षार्थी को उन चारों विकल्पों में से सही उत्तर छाँटना है। उत्तर को OMR आन्सर-शीट में सम्बन्धित प्रश्न संख्या में निम्न प्रकार भरना है :

**उदाहरण :**

**प्रश्न :**

प्रश्न 1 (A) ● (C) (D)
प्रश्न 2 (A) (B) ● (D)
प्रश्न 3 (A) ● (C) (D)

अपठनीय उत्तर या ऐसे उत्तर जिन्हें काटा या बदला गया है, या गोले में आधा भरकर दिया गया, उन्हें निरस्त कर दिया जाएगा।

5. प्रत्येक प्रश्न के अंक समान हैं। आपके जितने उत्तर सही होंगे, उन्हीं के अनुसार अंक प्रदान किये जायेंगे।

6. सभी उत्तर केवल ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर ही दिये जाने हैं। उत्तर-पत्रक में निर्धारित स्थान के अलावा अन्यत्र कहीं पर दिया गया उत्तर मान्य नहीं होगा।

7. ओ. एम. आर. उत्तर-पत्रक (OMR Answer Sheet) पर कुछ भी लिखने से पूर्व उसमें दिये गये सभी अनुदेशों को सावधानीपूर्वक पढ़ लिया जाये।

8. परीक्षा समाप्ति के उपरान्त परीक्षार्थी कक्ष निरीक्षक को अपनी OMR Answer Sheet उपलब्ध कराने के बाद ही परीक्षा कक्ष से प्रस्थान करें। परीक्षार्थी अपने साथ प्रश्न-पुस्तिका ले जा सकते हैं।

9. निगेटिव मार्किंग नहीं है।

10. कोई भी रफ कार्य, प्रश्न-पुस्तिका के अन्त में, रफ-कार्य के लिए दिए खाली पेज पर ही किया जाना चाहिए।

11. परीक्षा-कक्ष में लॉग-बुक, कैलकुलेटर, पेजर तथा सेल्युलर फोन ले जाना तथा उसका उपयोग करना वर्जित है।

12. प्रश्न के हिन्दी एवं अंग्रेजी रूपान्तरण में भिन्नता होने की दशा में प्रश्न का अंग्रेजी रूपान्तरण ही मान्य होगा।

**महत्वपूर्ण :** प्रश्नपुस्तिका खोलने पर प्रथमतः जाँच कर देख लें कि प्रश्न-पुस्तिका के सभी पृष्ठ भलीभाँति छपे हुए हैं। यदि प्रश्नपुस्तिका में कोई कमी हो, तो कक्षनिरीक्षक को दिखाकर उसी सिरीज की दूसरी प्रश्न-पुस्तिका प्राप्त कर लें।