Roll No. .....

Question Booklet Number

O. M. R. Serial No.

M. Sc. (Electronics) (Fourth Semester)

EXAMINATION, July, 2022

OPTOELECTRONICS & OPTICAL COMMUNICATION

Paper Code				
ELC	4	0	3	(N)

Questions Booklet Series
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Time : 1:30 Hours] [*Maximum Marks : 100*

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 60 questions. Examinee is required to answer any 50 questions in the OMR Answer-Sheet provided and not in the question booklet. If more than 50 questions are attempted by student, then the first attempted 50 questions will be considered for evaluation. 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 60 प्रश्न हैं। परीक्षार्थी को किन्हीं 50 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। यदि छात्र द्वारा 50 से अधिक प्रश्नों को हल किया जाता है तो प्रारम्भिक हल किये हुए 50 उत्तरों को ही मूल्यांकन हेतु सम्मिलित किया जाएगा। 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. Which of the following does not explain the requirements of an optical detector ?

(A) High quantum efficiency

(B) Low bias voltages

(C) Small size

(D) Low fidelity

2. The fraction of incident photons generated by photodiode of electrons generated collected at detector is known as :

(A) Responsivity

(B) Absorption coefficient

(C) Quantum efficiency

(D) Anger recombination

3. The scattering resulting from fiber imperfections like core-cladding RI differences, diameter fluctuations, strains and bubbles is :

(A) Rayleigh scattering

(B) Mie scattering

(C) SBS

(D) SRS

4. _____ are formed by sandwiching the butted fiber ends between a V-groove glass substrate and a flat glass retainer plate.

(A) Springroove splices

(B) V-groove splices

(C) Elastic splices

(D) Fusion splices

5. Which kind of dispersion phenomenon gives rise to pulse spreading in single mode fibers ?

(A) Intermodal dispersion

(B) Intramodal dispersion

(C) Material dispersion

(D) None of the above

6. The _____ at emitter-base junction gives good emitter base injection efficiency.

(A) Homo junction

(B) Depletion layer

(C) Holes

(D) Hetero junction

7. The numerical aperture for a step index fiber is sine angle of the _____.

(A) Attenuation

(B) Acceptance angle

(C) Aperture

(D) Efficient angle

8. If a photodiode requires incident optical power of 0.70 A/W. Determine photocurrent :

(A) 1.48

(B) 2.45

(C) 4.12

(D) 3.19

9. Which is the most important velocity in the study of transmission characteristics of optical fiber ?

(A) Phase velocity

(B) Group velocity

(C) Normalized velocity

(D) Average velocity

10. _____ in the laser occurs when photon colliding with an excited atom causes the stimulated emission of a second photon.

(A) Light amplification

(B) Attenuation

(C) Dispersion

(D) Population inversion

11. For a given guided mode, the normalized propagation constant lies between :

(A) $-\infty$ and ∞

(B) 0 and ∞

(C) 0 and 1

(D) –1 and 1

12. Inside an ideal dielectric medium :

(A) the free charge density ρ is zero and σ is non-zero.

(B) ρ is non-zero and σ is zero.

(C) Both ρ and σ are zero.

(D) Both ρ and σ are non-zero.

13. In transverse electric waves, which of the following is true ?

(A) E is parallel to H.

(B) E is parallel to wave direction.

(C) E is transverse to wave direction.

(D) H is transverse to wave direction.

14. PMMA stands for :

(A) Polymethacrylate

(B) Polymethyl methacrylate

(C) Polymer methacrylate

(D) None of the above

15. Optical fibers are not immune to :

(A) electronic disturbances

(B) magnetic disturbances

(C) electromagnetic disturbances

(D) ambient light interference

16. Optical fiber cable operates at wavelength near :

(A) 200-400 nm

(B) 400-800 nm

(C) 400-1100 nm

(D) 400-1600 nm

17. Optical communication are based on the principle of :

(A) Total internal reflection

(B) Reflection

(C) Refraction

(D) Refraction and TIR

18. The numerical aperture of an optical fiber depends on _____.

(A) core refractive index

(B) critical angle

(C) Both (A) and (B)

(D) None of the above

19. When a ray of light enters one medium from another medium, which quality will not change ?

(A) Direction

(B) Frequency

(C) Speed

(D) Wavelength

20. Meridional rays in graded index fibers follow :

(A) Straight path along the axis

(B) Curved path along the axis

(C) Path where rays change angles at core-cladding interface

(D) Helical path

21. How many mechanisms are there which cause absorption ?

(A) Three

(B) One

(C) Two

(D) Four

22. A single mode fiber has refractive indices $n_1 = 1.50$, $n_2 = 2.23$, core diameter of 8 μm, wavelength = 1 .5 μm, cut-off wavelength = 1.214 μm. Find the radius of curvature :

(A) 12 mm

(B) 20 mm

(C) 34 mm

(D) 36 mm

23. Absorption losses due to atomic defects mainly include _____.

(A) Radiation
(B) Impurities in fiber material
(C) Missing molecules, oxygen defects in glass
(D) Interaction with other components of core

24. A certain optical fiber has the following parameters : core radius of 4 μm, core and cladding refractive indices of 1.45 and 1.44 respectively and operating λ of 1064 nm. V-number of the fiber is :

(A) 3.11
(B) 1.82
(C) 2.405
(D) 3.5

25. Which equation is used to calculate MFD ?

(A) Maxwell's equations
(B) Peterman's equations
(C) Allen Calm's equations
(D) Boltzmann's equations

26. A multimode step index fiber has a normalized frequency of 72. Estimate the number of guided modes :

(A) 2846
(B) 2592
(C) 2432
(D) 2136

27. P_2O_5 is used as a _____.

(A) Dopant
(B) Starting material
(C) Cladding glass
(D) Core glass

28. Skew rays follow a _____.

(A) Hyperbolic path along the axis
(B) Parabolic path along the axis
(C) Helical path
(D) Path where rays changes angles at core-cladding interface

29. Mie scattering has in-homogeneities mainly in _____.

(A) Forward direction
(B) Backward direction
(C) Core-cladding interface
(D) All directions

30. Which processes are involved in the purification stage in liquid-phase-technique ?

(A) Filtration, Co-precipitation, Re-crystallization
(B) Decomposition, Filtration, Drying
(C) Doping, Drying, Decomposition
(D) Filtration, Drying, Doping

31. _____ technique is method of preparing extremely pure optical glasses.

(A) Direct melting method

(B) Radio frequency induction

(C) Vapor Phase Deposition (VPD)

(D) None of the above

32. What does micro-bending losses depend on ?

(A) Mode and wavelength

(B) Refractive index

(C) Diameter

(D) Core material

33. A particular fiber has a Fresnel reflection magnitude of 0.176. Find the power loss between the source and the fiber :

(A) 0.84 dB

(B) 0.78 dB

(C) 0.86 dB

(D) 0.83 dB

34. Which of the following materials is not used as a starting material in vapor-phase deposition ?

(A) $SiCl_4$

(B) $GeCl_4$

(C) O_2

(D) B_2O_3

35. A device that reduces the intensity of light in optical fiber communications is _____.

(A) Compressor

(B) Optical attenuator

(C) Barometer

(D) Reducer

36. Multimode step index fiber has _____.

(A) Large core diameter and small NA

(B) Large core diameter and large NA

(C) Small core diameter and large NA

(D) Small core diameter and small NA

37. In multimode fibers, which is the most beneficial index profile ?

(A) Step index

(B) Graded index

(C) Step and graded index

(D) None of the above

38. The fibers mostly not used nowadays for optical fiber communication system are _____.

(A) Multimode graded index fibers

(B) Multimode step fibers

(C) Coaxial cables

(D) Single mode fibers

39. Rayleigh scattering and Mie scattering are the types of _____.

(A) Linear scattering losses

(B) Non-linear scattering losses

(C) Fiber bends losses

(D) Splicing losses

40. When the input and output power in an optical fiber is 120 μW and 3 μW respectively and the length of the fiber is 8 km. What is the signal attenuation per km for the fiber ?

(A) 3 dB/km

(B) 2 dB/km

(C) 1 dB/km

(D) 4 dB/km

41. What is dispersion in optical fiber communication ?

(A) Broadening of transmitted light pulses along the channel

(B) Compression of light pulses

(C) Overlapping of light pulses on compression

(D) Absorption of light pulses

42. The optical source used in a fiber is an injection laser with a relative spectral width $\sigma\lambda/\lambda$ of 0.0011 at a wavelength of 0.70 μm. Estimate the RMS spectral width :

(A) 1.2 nm

(B) 1.3 nm

(C) 0.77 nm

(D) 0.98 nm

43. What is the main requirement with the fibers that are intended for splicing ?

(A) Smooth and oval end faces

(B) Smooth and square end faces

(C) Rough edge faces

(D) Large core diameter

44. In a single mode fiber, the losses due to lateral offset and angular misalignment are given by 0.20 dB and 0.46 dB respectively. Find the total insertion loss :

(A) 0.66 dB

(B) 0.26 dB

(C) 0.38 dB

(D) 0.40 dB

45. A Ruby laser has a crystal of length 3 cm with a refractive index of 1.60, wavelength 0.43 μm. Determine the number of longitudinal modes :

(A) $l.5 \times 10^2$

(B) 3.3×10^6

(C) 2.8×10^5

(D) 2.2×10^5

46. For a GaAs LED, the coupling efficiency is 0.05. Compute the optical loss in decibels :

(A) 11.3 dB

(B) 12 dB

(C) 13.01 dB

(D) 16.6 dB

47. The elemental semiconductors are not used for optical radiation because :

(A) Indirect band gap materials

(B) Direct band gap materials

(C) Both (A) and (B)

(D) None of the above

48. What is the use of interposed optics in expanded beam connectors ?

(A) For index-matching

(B) To make a fiber loss free

(C) To make a fiber dispersive

(D) To achieve lateral alignment less critical than a butt-joined fiber connector

49. A measure of amount of optical fiber emitted from source that can be coupled into a fiber is termed as _____.

(A) Coupling efficiency

(B) Angular power distribution

(C) Radiance

(D) Power-launching

50. Raman and Brillouin scattering are usually observed at _____.

(A) Low optical power densities

(B) Medium optical power densities

(C) High optical power densities

(D) Threshold power densities

51. What does ISI stand for in optical fiber communication ?

(A) Invisible size interference

(B) Infrared size interference

(C) Inter-symbol interference

(D) Inter-shape interference

52. The cable must be designed such that the strain on the fiber in the cable does not exceed _____.

(A) 0.160%

(B) 0.002%

(C) 0.01%

(D) 0.2%

53. A permanent joint formed between two different optical fibers in the field is known as a _____.

(A) Fiber attenuator

(B) Fiber connector

(C) Fiber splice

(D) Fiber dispersion

54. Which of the following is not used as a flame heating source in fusion splicing ?

(A) Electric torch

(B) Ox hydric burner

(C) Electric arc

(D) Gas burner

55. A semiconductor laser crystal of length 5 cm, refractive index 1.8 is used as an optical source. Determine the frequency separation of the modes :

(A) 2.8 GHz

(B) 1.6 GHz

(C) 1.2 GHz

(D) 2 GHz

56. _____ converts the received optical signal into an electrical signal.

(A) Detector

(B) Attenuator

(C) Laser

(D) LED

57. A GaAs optical source having a refractive index of 3.2 is coupled to a silica fiber having a refractive index of 1.42. Determine Fresnel reflection at interface in terms of percentage :

(A) 14.8%

(B) 17.4%

(C) 17.6%

(D) 13.4%

58. Which of the following is not a strength member used in optical cable ?

(A) Steel wire

(B) Germanium

(C) Aramid yams

(D) Glass elements

59. Stimulated Brillouin scattering is mainly a :

(A) Forward process

(B) Backward process

(C) Upward process

(D) Downward process

60. The cable is normally covered with an outer plastic sheath to reduce _____.

(A) Abrasion

(B) Attenuation

(C) Friction

(D) Dispersion

4. Four alternative answers are mentioned for each question as—A, B, C & D in the booklet. The candidate has to choose the most correct/appropriate 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 ny 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 एक सबसे सही अथवा सबसे उपयुक्त 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।