Roll No. ....

Question Booklet Number

O. M. R. Serial No.

M. Sc. (Electronics) (Fourth Semester) (NEP) EXAMINATION, 2025-26

PROCESSES IN DEVICE FABRICATION

Paper Code							
B	1	4	1	0	0	6	T

Questions Booklet Series
D

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. Which of the following is an example of wet etching :

   (A) Plasma etching

   (B) Reactive ion etching (RIE)

   (C) Chemical solution etching

   (D) Sputtering

2. Etching in IC fabrication is primarily used for :

   (A) Doping the semiconductor

   (B) Removing selected material from the wafer surface

   (C) Depositing thin films

   (D) Growing oxide layers

3. Which factor does NOT significantly affect the diffusion rate in silicon ?

   (A) Temperature

   (B) Dopant concentration

   (C) Crystal defects

   (D) Wafer colour

4. In constant source diffusion, the dopant profile is best described by :

   (A) Gaussian distribution

   (B) Linear distribution

   (C) Exponential decay

   (D) Error function (erfc)

5. Which diffusion mechanism involves dopant atoms moving through vacant lattice sites ?

   (A) Interstitial diffusion

   (B) Vacancy diffusion

   (C) Grain boundary diffusion

   (D) Surface diffusion

6. The diffusion of dopants in silicon primarily follows which law :

   (A) Ohm's Law

   (B) Newton's Law

   (C) Fick's Laws

   (D) Stefan's Law

7. The dose in ion implantation is defined as :

   (A) Number of ions per unit area

   (B) Energy per ion

   (C) Depth of penetration

   (D) Implantation time

8. Which phenomenon describes ions travelling deeper along crystallographic directions due to fewer collisions :

   (A) Scattering

   (B) Diffusion

   (C) Sputtering

   (D) Channelling

9. The damage caused to the crystal lattice during ion implantation is typically repaired by :
   (A) Oxidation
   (B) Etching
   (C) Annealing
   (D) Lithography

10. Which of the following is the main advantage of ion implantation over diffusion ?
   (A) Lower cost
   (B) Precise control of dopant concentration and depth
   (C) Higher throughput
   (D) No lattice damage

11. In ion implantation, the projected range (Rp) of implanted ions primarily depends on :
   (A) Ion energy
   (B) Substrate temperature
   (C) Oxide thickness
   (D) Ambient pressure

12. Heavily doped silicon oxidizes :
   (A) Slower than intrinsic silicon
   (B) At the same rate
   (C) Independently of doping
   (D) Faster than intrinsic silicon

13. Crystal orientation affects oxidation rate such that :
   (A) (111) oxidizes slower than (100)
   (B) (100) oxidizes faster than (111)
   (C) Both are same
   (D) Orientation has no effect

14. Oxide masking property is used in :
   (A) Etching
   (B) Metallization
   (C) Polishing
   (D) Diffusion and ion implantation blocking

15. Fixed oxide charges are typically located :
   (A) In silicon bulk
   (B) In metal layer
   (C) At Si-SiO_2 interface
   (D) In gas phase

16. Mobile ionic charges in oxide are commonly due to :
   (A) Oxygen ions
   (B) Sodium ions
   (C) Silicon atoms
   (D) Hydrogen gas

17. Oxide stress arises mainly due to :

(A) Thermal mismatch and volume expansion

(B) Doping concentration

(C) Wafer size

(D) Pressure variation

18. High-quality oxide is characterized by :

(A) High defect density

(B) High stress

(C) Low interface trap density

(D) High leakage

19. Oxidation Induced Stacking Faults (OISF) are caused by :

(A) Mechanical polishing

(B) Ion implantation

(C) Plasma damage

(D) Excess silicon interstitials

20. OISF density increases with :

(A) Higher oxidation temperature

(B) Lower oxygen concentration

(C) Lower temperature

(D) Short oxidation time

21. Polysilicon oxidation differs from single crystal silicon because :

(A) No stress formation

(B) Lower diffusivity

(C) Grain boundaries enhance oxidation rate

(D) No oxidation occurs

22. The Deal-Grove model assumes :

(A) Non-steady-state diffusion

(B) Steady-state diffusion through oxide

(C) Plasma reactions

(D) No diffusion

23. Initial oxide growth deviates from Deal-Grove model due to :

(A) Doping

(B) Pressure changes

(C) Stress relaxation

(D) Thin oxide effects and interface kinetics

24. Chlorine in oxidation ambient reduces :

(A) Temperature

(B) Oxidation rate

(C) Interface trap density

(D) Oxide thickness

25. Plasma oxidation advantage includes :

(A) Low temperature processing

(B) High thermal budget

(C) High defect density

(D) Slow growth

26. Chemical Mechanical Polishing (CMP) is used to :

(A) Increase wafer thickness

(B) Remove oxide

(C) Achieve planar surface

(D) Add impurities

27. Wafer flat/notch indicates :

(A) Thickness

(B) Doping level

(C) Crystal orientation

(D) Surface roughness

28. The Deal-Grove model describes :

(A) Crystal defects

(B) Oxidation kinetics

(C) Epitaxy growth

(D) Zone refining

29. Oxide growth rate is faster in :

(A) Wet oxidation

(B) Dry oxidation

(C) Vacuum oxidation

(D) Plasma oxidation

30. Wet oxidation uses :

(A) Oxygen

(B) Helium

(C) Nitrogen

(D) Steam (H_2O vapour)

31. Dry oxidation uses :

(A) Water vapour

(B) Oxygen gas

(C) Nitrogen gas

(D) Hydrogen gas

32. Thermal oxidation of silicon produces :

(A) Si_3N_4

(B) SiO_2

(C) SiC

(D) SiH

33. Buried layers in semiconductor devices are used to :

(A) Reduce substrate interaction

(B) Improve isolation

(C) Increase resistance

(D) Increase thickness

34. Epitaxial defects include :

(A) Voids only

(B) Dislocations and stacking faults

(C) Only vacancies

(D) Only interstitials

35. In VPE, the silicon source gas is commonly :

(A) Oxygen

(B) Argon

(C) Nitrogen

(D) Silane (SiH_4)

36. Which technique provides the highest control over layer thickness ?

(A) MBE

(B) VPE

(C) LPE

(D) Zone refining

37. The growth rate in MBE is :

(A) Very high

(B) Moderate

(C) Very slow and controlled

(D) Uncontrolled

38. Molecular Beam Epitaxy (MBE) operates under :

(A) Atmospheric pressure

(B) High pressure

(C) Ultra-high vacuum

(D) Liquid medium

39. Liquid Phase Epitaxy (LPE) uses :

(A) Liquid melt

(B) Plasma

(C) Vacuum deposition

(D) Ion implantation

40. Vapour Phase Epitaxy (VPE) involves :

(A) Liquid reactants

(B) Solid diffusion

(C) Gas phase chemical reactions

(D) Ion beams

41. Epitaxial growth refers to :

(A) Growth of amorphous layer

(B) Growth of polycrystalline layer

(C) Growth of single crystal layer on substrate

(D) Growth of oxide layer

42. Dislocations in crystals are classified as :

(A) Line defects

(B) Surface defects

(C) Point defects

(D) Volume defects

43. Which defect arises due to missing atoms in a lattice ?

(A) Interstitial defect

(B) Grain boundary

(C) Line defect

(D) Vacancy defect

44. Lapping and polishing of wafers are done to :

(A) Increase thickness

(B) Improve surface smoothness

(C) Add impurities

(D) Change crystal orientation

45. Silicon wafers are sliced from ingots using :

(A) Chemical etching

(B) Ion implantation

(C) Thermal oxidation

(D) Diamond saw

46. In zone refining, impurities tend to :

(A) Remain stationary

(B) Move with molten zone

(C) Evaporate

(D) Crystallize first

47. The primary purpose of zone refining is :

(A) Purification of silicon

(B) Doping

(C) Crystal shaping

(D) Wafer polishing

48. In the Czochralski process, the seed crystal is used to :

(A) Melt silicon

(B) Initiate crystal growth with proper orientation

(C) Remove impurities

(D) Cool the melt

49. The most widely used method for single crystal silicon growth is :

(A) Zone refining

(B) Czochralski method

(C) Bridgman method

(D) Sol-gel method

50. Electronic grade silicon used in semiconductor fabrication typically has a purity of :

(A) 99%

(B) 99.9%

(C) 99.9999%

(D) 90%

51. Which is the software used in VLSI :

(A) Xilinx

(B) Cadence

(C) LOON

(D) Both (A) & (B)

52. SEM uses which type of beam :

(A) Electron beam

(B) Light beam

(C) X-ray beam

(D) Ion beam

53. Which technique is non-destructive for thickness measurement :

(A) Profilometry

(B) Etching

(C) Spreading resistance

(D) Ellipsometry

54. In I-V measurement, breakdown voltage is obtained from :

(A) Linear region

(B) Saturation region

(C) Reverse bias region

(D) Threshold region

55. A glass photomask consist of :

(A) Transparent part

(B) Opaque part

(C) Both (A) and (B)

(D) None of above

56. Raman spectroscopy is based on :

(A) Elastic scattering

(B) Inelastic scattering of light

(C) Electron emission

(D) Capacitance variation

57. UV-VIS spectrometer is used to study :

(A) Optical absorption

(B) Crystal defects

(C) Surface morphology

(D) Resistivity

58. The working principle of XRD is based on :

(A) Electron emission

(B) Ohm's law

(C) Beer-Lambert law

(D) Bragg's law

59. XRD is primarily used to determine :

(A) Electrical properties

(B) Crystal structure

(C) Surface roughness

(D) Optical absorption

60. Dielectric constant is measured using :

(A) C-V technique

(B) I-V technique

(C) SEM

(D) XRD

61. Spreading resistance technique is used for :

(A) Surface imaging

(B) Thickness measurement

(C) Optical analysis

(D) Depth profiling of resistivity

62. The four-probe technique is mainly used to measure :

(A) Resistivity

(B) Thickness

(C) Capacitance

(D) Dielectric constant

63. In two-probe method, measured resistance includes :

(A) Only sample resistance

(B) Contact resistance only

(C) Sample + contact resistance

(D) No resistance

64. In C-V measurement, capacitance is measured as a function of :

(A) Temperature

(B) Voltage

(C) Frequency only

(D) Current

65. The principle of I-V measurement is based on :

(A) Ohm's law

(B) Capacitance variation

(C) Diffraction

(D) Polarization

66. Thickness of thin films is most accurately measured using :

(A) SEM

(B) XRD

(C) UV-VIS

(D) Ellipsometer

67. Which material is most commonly used for metallization in IC fabrication ?

(A) Aluminum

(B) Gold

(C) Copper

(D) Tungsten

68. The primary purpose of metallization in IC fabrication is to :

(A) Dope the semiconductor

(B) Form insulating layers

(C) Grow oxide layers

(D) Create electrical interconnections

69. Which technique is widely used for depositing metal layers in IC fabrication ?
   (A) Chemical Vapour Deposition (CVD)
   (B) Physical Vapour Deposition (PVD)
   (C) Oxidation
   (D) Ion Implantation

70. What is the main disadvantage of allumium metallization ?
   (A) Electromigration
   (B) High resistivity
   (C) Poor adhesion
   (D) Low melting point

71. Which metal is increasingly used in advanced ICs due to its lower resistivity compared to aluminium ?
   (A) Silver
   (B) Nickel
   (C) Platinum
   (D) Copper

72. The barrier layer in metallization is mainly used to :
   (A) Improve conductivity
   (B) Prevent diffusion of metal into silicon
   (C) Increase oxide thickness
   (D) Reduce capacitance

73. Which process is used to define metal patterns after deposition ?
   (A) Lithography and Etching
   (B) Diffusion
   (C) Oxidation
   (D) Annealing

74. One major limitation common to advanced lithography techniques is :
   (A) Low precision
   (B) High cost of equipment
   (C) No need for masks
   (D) Low resolution

75. Mask generation in electron beam lithography is mainly used for :
   (A) Creating photomasks
   (B) Direct wafer patterning
   (C) Doping
   (D) Etching

76. Electron beam resists are typically :
   (A) Magnetic materials
   (B) Electron-sensitive polymers
   (C) Metals
   (D) Oxides

77. A major challenge in X-ray lithography is :

(A) Mask fabrication

(B) Wafer cleaning

(C) Low temperature

(D) Ion diffusion

78. The main advantage of X-ray lithography is :

(A) Low cost

(B) High throughput

(C) High resolution and low diffraction

(D) Simple equipment

79. X-ray lithography uses radiation with :

(A) Long wavelength

(B) Medium wavelength

(C) No wavelength

(D) Very short wavelength

80. In electron beam lithography, pattern writing is typically :

(A) Serial

(B) Parallel

(C) Random

(D) Optical

81. The main limitation of electron beam lithography is :

(A) Poor resolution

(B) Slow writing speed

(C) High defect rate

(D) Low accuracy

82. A key advantage of electron beam lithography is :

(A) Very high resolution

(B) High throughput

(C) Low cost

(D) Simple masks

83. Electron beam lithography uses :

(A) UV light

(B) X-rays

(C) Focused electron beam

(D) Laser only

84. The main component used for pattern definition in lithography is :

(A) Wafer

(B) Mask

(C) Furnace

(D) Diffuser

85. Resolution in optical lithography is limited by :

(A) Wavelength of light

(B) Temperature

(C) Pressure

(D) Voltage

86. Projection printing uses :

(A) Direct contact

(B) Lenses to project image

(C) Magnetic fields

(D) Ion beams

87. In proximity printing, the gap between mask and wafer is typically :

(A) Zero

(B) Very large

(C) Infinite

(D) Small (few micrometers)

88. The delay fault considered as :

(A) Electrical fault

(B) Logical fault

(C) Physical fault

(D) None the above

89. The major disadvantage of contact printing is :

(A) Mask damage

(B) Low resolution

(C) High cost

(D) Slow process

90. Contact printing in lithography refers to :

(A) Mask placed far from wafer

(B) Mask touching wafer surface

(C) Mask inside wafer

(D) No mask used

91. A positive photoresist becomes :

(A) Harder when exposed to light

(B) Insoluble after exposure

(C) Unaffected by light

(D) More soluble in developer after exposure

92. Photoresists used in optical lithography are generally :

(A) Light-sensitive materials

(B) Conductors

(C) Insulators

(D) Magnetic materials

93. Which lithography technique uses UV light for pattern transfer :

(A) Electron beam lithography

(B) X-ray lithography

(C) Optical lithography

(D) Ion implantation

94. Lithography in IC fabrication is primarily used for :

(A) Doping silicon

(B) Pattern transfer onto wafer

(C) Oxidation of silicon

(D) Crystal growth

95. Undercutting is a common issue in :

(A) Wet isotropic etching

(B) Anisotropic etching

(C) Dry etching

(D) Ion implantation

96. Which gas is commonly used in plasma etching of silicon :

(A) Oxygen

(B) Nitrogen

(C) CF_4

(D) Hydrogen

97. Selectivity in etching refers to :

(A) Speed of etching

(B) Ability to etch only one material over another

(C) Temperature control

(D) Ion energy

98. Which etching technique provides the best directionality and control :

(A) Reactive Ion Etching (RIE)

(B) Wet etching

(C) Chemical cleaning

(D) Isotropic etching

99. Anisotropic etching is characterized by :

(A) Equal etching in all directions

(B) No material removal

(C) Only surface cleaning

(D) Faster etching in vertical direction than lateral

100. After CZ process we get :

(A) wafer

(B) Ingot

(C) Si- Die

(D) None of above

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

   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 Ⓐ ● Ⓒ Ⓓ
   प्रश्न 2 Ⓐ Ⓑ ● Ⓓ
   प्रश्न 3 Ⓐ ● Ⓒ Ⓓ

   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 प्रथमत: 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।