# Bangladesh Electronics Olympiad 2015

11 December 2015, Curzon Hall, University of Dhaka, Bangladesh

Web: *http://eo-bd.org*

Questions start here:

1. Which one is the terminal of a diode?
   a. Cathode√
   b. Emitter
   c. Collector
   d. Base
2. Which voltage level is assigned for binary one?
   a. 0 V
   b. 5 V√
   c. -5 V
   d. 220 V (AC, rms)
3. Which one is not a basic logic gate?
   a. AND
   b. OR
   c. Flip-Flop√
   d. XOR
4. Which one is not belong to any logic family?
   a. TTL
   b. CMOS
   c. BiCMOS
   d. Op-Amp√
5. Which is the equation of XOR gate?
   a. $Y = AB + \overline{A}\overline{B}$
   b. $Y = \overline{A}B + A\overline{B}$ √
   c. $Y = AB + \overline{A}B$
   d. $Y = AB + A\overline{B}$
6. ALU stands for-
   a. Arithmetic Logic Union
   b. Arithmetic Logic Unit√
   c. Arithmetic Logical Union
   d. Arithmetic Logic United
7. LED emits:
   a. Photon√
   b. Phonon
   c. Electron
   d. Hole
8. Which one frequency may be a FM radio station frequency?
   a. 50 Hz
   b. 4 GHz
   c. 90 MHz√
   d. 6 kHz
9. If lower cut-off frequency is 300 Hz and upper cut-off frequency is 3400 Hz then what would be the band width?
   a. 3700 Hz
   b. 3100 Hz√
   c. 1850 Hz
   d. 3400 Hz
10. Which is not the EEG frequency band?
    a. $\alpha$
    b. $\beta$
    c. $\theta$
    d. $\eta$√
11. Which one is not a class of power amplifier?
    a. A
    b. AB
    c. D
    d. P√
12. Which one is not an operational parameter of a MOSFET?
    a. Threshold voltage
    b. Pinch off voltage
    c. Base current√
    d. Drain current
13. If sampling frequency is 4 kHz then what is the minimum bandwidth?
    a. 8 kHz√
    b. 2 kHz
    c. 4 kHz
    d. 16 Hz
14. Communication channel capacity theory has been given by-
    a. Shannon√
    b. Nyquist

c. Bode
d. Bell

15. What is the time period of a 50 Hz sine wave-
    a. 20 μs
    b. 20
    c. 20 s
    d. 20 ms√

16. The amplitude of a 50 Hz sine voltage wave at some instant of time $t_1$ is 0.55 V. What is the amplitude of this wave at the time instant of $t_1 + T$?
    a. 0.55 V√
    b. -0.55 V
    c. 0 V
    d. Can't be determined

17. A sine voltage wave is of the following form:

$$v(t) = 2\sin\left(628t + \frac{\pi}{4}\right) \text{ Volt}$$

What is the peak amplitude and frequency respectively?
    a. 2 V and 100 Hz
    b. √2 V and 50 Hz
    c. √2 V and 314 Hz
    d. 2 V and 50 Hz√

18. What is the function of bio-electrode arc sensor?
    a. To transduce electronic conduction to ionic conduction
    b. To transduce ionic conduction to electronic conduction√
    c. To transduce electrical conduction to electronic conduction
    d. To transduce chemical conduction to electronic conduction

19. Which one is not medically significant bioelectric signal?
    a. Electrocardiographic (ECG)
    b. Electroencephalographic (EEG)
    c. Electromyographic (EMG)
    d. Blood Pressure√

20. Which of the following part is not used in an impedance pneumograph that is used to measure the rate and existence of respiration?
    a. AC Amplifier
    b. Synchronous Detector
    c. Carrier Oscillator
    d. Integrator√

21. Which of the following material is not used for detecting medical ultra-sound?
    a. Quartz
    b. Barium Titanate
    c. Lead Zirconate Titanate
    d. Silicon√

22. Which of the following material has highest amount of acoustical impedance?
    a. Water
    b. Air
    c. Muscle
    d. Bone√

23. If the energy level of 6.626×10-18 J is imparted to an electron stream by an X-ray machine then what is the frequency generated by the machine?
    a. 10 MHz
    b. 10 GHz
    c. 10 THz√
    d. 10 PHz

24. Basically, what are the quantum effects that exist for electromagnetic waves?
    a. Photoelectric effect
    b. Compton effect
    c. Bremsstrahlung
    d. All of the above√

25. Which method not is related to eye-tracking?
    a. Electro-retinogram (ERG)
    b. Electro-oculogram (EOG)
    c. Both 'a' and 'b'
    d. Electro-encephalogram (EEG)√

26. Which of the following particles/ rays are produced by ionizing radiation?
    a. α-particles
    b. β-particles
    c. γ-rays
    d. All of the above√

27. Which is the function of piezoelectric material?
    a. Converts mechanical signal into electrical signal
    b. Converts electrical signal into mechanical signal
    c. Both 'a' and 'b'√
    d. None of the above

28. What is the full meaning of LASER?
    a. Light Amplification by Stimulated Electrical Ray

b. Light Amplification by Stimulated Electrical Radiation
c. Light Amplification by Stimulated Emission of Radiation√
d. Light Amplification by Stimulated Electronic Radiation

29. A typical LASER operates with a current of 10 mA at a dc voltage of 2500 V and gives an optical power output of 5 mW. What is the overall power efficiency of this LASER?
a. 2 %
b. 0.2 %
c. 0.02 %√
d. Can't be determined

30. What does 22 nm MOSFET imply?
a. Junction depth of the MOSFET is 22 nm
b. Channel Length of the MOSFET is 22 nm√
c. Channel Width of the MOSFET is 22 nm
d. Inversion layer thickness of the MOSFET is 22 nm

31. Which one is not a LASER?
a. Ruby LASER
b. Nd:YAG LASER
c. He-Ne LASER
d. Si LASER√

32. Who did not won the Nobel Prize in Physics for inventing blue LED in 2014?
a. Isamu Akasaki
b. Hiroshi Amano
c. Shuji Nakamura
d. Hiroshi Nakamura√

33. Who did not won the Nobel Prize in Physics for inventing transistor in 1956?
a. William Bradford Shockley
b. John Bardeen
c. Walter Houser Brattain
d. Konstantin Novoselov√

34. Which statement is not true for photo-conductor?
a. If light increases then resistance increases√
b. If light increases then resistance decreases
c. If length of the conductor decreases then photo-conductive gain increases
d. If mobility increases then conductivity increases

35. Which one is not an integrated eletro-optic modulator?
a. Pockels cell phase modulator
b. Polarization modulator
c. Mach-Zehnder modulator
d. Quadrature phase shift modulator√

36. Which of the following case results in increase of the diffracted optic beam frequency?
a. When the acoustic wave is traveling towards the outgoing optical beam
b. When the acoustic wave is traveling away from the outgoing optical beam
c. When the acoustic wave is traveling towards the incoming optical beam√
d. When the acoustic wave is traveling away from the incoming optical beam

37. Which one is not a parameter upon which the amount of rotation depends in magneto-optic effect?
a. Verdet constant
b. Length of the medium
c. Magnetic flux density
d. Strain√

38. Which effect causes the linear electro-optic effect?
a. Kerr effect
b. Pockels effect√
c. Photoelastic effect
d. Seebeck effect

39. What does change in a material due to electro-optic effect?
a. Refractive index√
b. Magnetic flux density
c. Magnetic permeability
d. Magnetic susceptibility

40. In which layer built-in electric field, $E_0$ is produced in a *p*-*n* junction solar cell?
a. Thin *n*-layer
b. Wide *p*-layer
c. Depletion layer√
d. Thin *p*-layer

41. What is solar constant?
a. AM0√

b. AM1.0
c. AM1.5
d. AM2.0

42. Which has the highest spectral intensity?
a. AM0
b. AM1.0
c. AM1.5
d. Black body radiation at 6000K√

43. Which equation defines fill factor?
a. $FF = \frac{I_{sc}V_{oc}}{I_m V_m}$
b. $FF = \frac{I_m V_m}{I_{sc}V_{oc}}$ √
c. $FF = \frac{I_{oc}V_{sc}}{I_{sc}V_{oc}}$
d. $FF = \frac{I_{rms}V_{rms}}{I_{sc}V_{oc}}$

44. Which one is not a photon detector?
a. LED√
b. APD
c. LDR
d. *p-i-n* photo-diode

45. Which quadrant is the region of operation of a *p-n* junction solar cell?
a. I
b. II
c. III
d. IV√

46. If a family consumes 500 W electrical power in sunny days over one year, and annual solar intensity per day is 6 kWh/m$^2$ and a solar cell has 20% efficiency then what is the required area of the solar panel of the solar cell used for that house?
a. 10
b. 0.4 m$^2$
c. 2 m$^2$
d. 10 m$^2$√

47. In which velocity an electron is expected to travel in a photo-detector when applied electric field is around $10^7$ V/m?
a. Normal Velocity
b. Diffusion Velocity
c. Saturation Velocity√
d. Mean Drift Velocity

48. Which material is indirect band gap material?
a. InAs
b. InSb
c. Si and Ge√
d. InP

49. What does a solar cell do?
a. Converts sun light signal into sound signal
b. Converts sun light signal into electrical signal
c. Converts sun light signal into heat signal √
d. Converts electrical signal into light signal

50. What does a pyro-electric detector do?
a. Converts heat signal into light signal
b. Converts light signal into electrical signal
c. Converts light signal into heat signal √
d. Converts sun light signal into electrical signal

51. What does a photoconductor do?
a. Converts light signal into sound signal
b. Converts light signal into electrical signal√
c. Converts light signal into heat signal
d. Converts electrical signal into light signal

52. Which one is a quarternary alloy?
a. AlGaAsP√
b. GaAs
c. InGaAlAsP
d. GaAsP

53. What is the value of band gap energy of blue LED?
a. 1.4 eV
b. 1.1 eV
c. 2.0 eV√
d. 4.0 eV

54. A Si sample is doped with $10^{17}$ As atoms/cm$^3$. What is the concentration of hole at thermal equilibrium and at temperature of 300K? Intrinsic carrier concentration of Si atom is $1.5\times10^{10}$ cm$^{-3}$ and band gap energy is 1.1 eV.
a. $1.5\times10^{10}$ cm$^{-3}$
b. $2.25\times10^{3}$ cm$^{-3}$√
c. $2.25\times10^{3}$ cm$^{3}$

d. $6.67\times10^{6}$ $cm^{-3}$

55. For the above problem, where is $E_F$ relative to $E_v$?
    a. 0.55 eV
    b. 1.1 eV
    c. 0.957 eV√
    d. 0.407 eV

56. Which method is not used for semiconductor fabrication process?
    a. Photolithography
    b. Crystallography
    c. Oculography√
    d. Etching

57. Which chemical is used for etching purpose?
    a. HF
    b. $HNO_3$
    c. $H_2SO_4$
    d. All of the above√

58. What is the resistivity of intrinsic Ge at 300K? Given that $\mu_n$ = 3900 $cm^2$/V.s, $\mu_p$ = 1900 $cm^2$/V.s and $n_i = 2.5\times10^{13}$ $cm^{-3}$ for Ge.
    a. 0.0232 /Ω-cm
    b. 0.0232 Ω-cm
    c. 43 /Ω-cm
    d. 43 Ω-cm √

59. Which statement is not true for semiconductor materials?
    a. Electron is the majority carrier in *n*-type semiconductor material
    b. Hole is the majority carrier in *p*-type semiconductor material
    c. Electron is the majority carrier in *p*-type semiconductor material√
    d. Doped semiconductor material is called extrinsic material

60. What is the band gap energy for semiconductor materials?
    a. Mean value of conduction band and valence band energy levels
    b. Mean squared value of conduction band and valence band energy levels
    c. Sum of conduction band and valence band energy levels
    d. Difference between conduction band and valence band energy levels√

61. Which method is used for semiconductor doping profile measurement?
    a. Photolithography
    b. Crystallography
    c. Scanning Capacitance Microscopy√
    d. Molecular Beam Epitaxy

62. When Hall Effect is produced in a semiconductor sample?
    a. Magnetic field is applied in the same direction of current flow
    b. Magnetic field is applied in the perpendicular direction of current flow√
    c. Magnetic field is applied in the opposite direction of current flow
    d. Magnetic field is applied in any direction of current flow

63. When Hall Effect is produced in a semiconductor sample, which force is created on the carrier?
    a. Lorenz force
    b. Coulombic force
    c. Lorentz force√
    d. Hall force

64. "Algebraic sum of all currents at a junction of an electrical network is zero"- this is called-
    a. Kirchhoff's Voltage Law
    b. Ampere's Current Law
    c. Kirchhoff's Current Law√
    d. Ohm's Law

65. "The number of transistors in a dense integrated circuit doubles approximately every years"- this observation was first given in 1965 by-
    a. Gordon E. Moore√
    b. Carver Mead
    c. Arthur Rock
    d. Lawrence Krauss

66. Who invented CMOS logic circuits in 1963 for the first time?
    a. Gordon E. Moore
    b. Dr. Frank Marion Wanlass√
    c. Arthur Rock
    d. Steve Jobs

67. How many transistors may have in a Medium Scale Integrated (MSI) Circuit?
    a. 10
    b. 100√
    c. 1000
    d. 10000

68. Which of the following is the world's first microprocessor?
    a. Intel 4004√
    b. IBM PC's 8088
    c. IBM PC's 8086
    d. IBM PC's 8085
69. Which of the following is not true for four-phase logic?
    a. It is a dynamic logic
    b. It uses either PMOS or NMOS processes
    c. It uses a kind of 4-phase clock signal
    d. It is a static logic√
70. Which of the following series of integrated circuit is analog?
    a. 4000
    b. 4500
    c. 7400
    d. LMxxx√
71. Who invented the Dynamic Random Access Memory (DRAM) technology at IBM in 1967?
    a. Robert Noyce
    b. Jack Kilby
    c. Frank Marion Wanlass
    d. Robert Dennard√
72. What materials are used for the transistors invented by the IBM with 7 nm node chips in 2015?
    a. C-Si
    b. Al-Si
    c. Ga-As
    d. Si-Ge√
73. What is the full meaning of DDR-SDRAM?
    a. Double Data Rate Static Dynamic Random-Access Memory
    b. Double Data Rate Synchronous Dynamic Random-Access Memory√
    c. Double Data Refreshing Static Dynamic Random-Access Memory
    d. Double Data Refreshing Synchronous Dynamic Random-Access Memory
74. What is the maximum transfer rate of DDR2-SDRAM with data being transferred 64 bits at a time and with memory clock frequency of 200 MHz?
    a. 800 MB/s
    b. 1600 MB/s
    c. 3200 MB/s
    d. 6400 MB/s√
75. What is the similarity between MOSFET and CNTFET?
    a. Both are unipolar device√
    b. Both can give same current for same gate over drive voltage
    c. Both have the same carrier mobility
    d. Both have the same effective gate capacitance
76. How many terminals a CNTFET have?
    a. 2
    b. 3
    c. 4√
    d. 5
77. What are the parameters upon which noise margin and voltage transfer characteristics (VTC) of an inverter depends?
    a. $V_{DD}$, $V_{SS}$, $V_{IL}$ and $V_{OL}$
    b. $V_{OH}$, $V_{IH}$, $V_{DD}$ and $V_{SS}$
    c. $V_{OH}$, $V_{IH}$, $V_{IL}$ and $V_{OL}$√
    d. $V_{OH}$, $V_{IH}$, $V_{IN}$ and $V_{OUT}$
78. What is the dynamic power dissipation in an inverter operated from a 5 V power supply? The inverted has a 2 pF capacitive load and is switched at 50 MHz.
    a. 2.5 mW√
    b. 5 mW
    c. 0.5 mW
    d. 50 mW
79. An NMOS inverter circuit is designed with a supply voltage of 5 V and pull-up resistance of 1 kΩ. When it is turned on, ON resistance of NMOS transistor is 100 Ω and offset voltage is 0.1 V. What is the value of output voltage at LOW condition?
    a. 0.5 V
    b. 0.4 V
    c. 0.55 V√
    d. 0.6 V
80. Which mathematical operation can be implemented by an op-amp based circuit?
    a. Differentiation and Integration
    b. Addition and Subtraction
    c. Slope Changing
    d. All of the above√
81. Which of the following component an active filter must contain?
    a. Resistor

b. Inductor
c. Capacitor
d. Transistor√

82. Which is not the characteristic of an ideal op-amp?
a. Infinite open loop gain
b. Zero input impedance√
c. Zero output impedance
d. Infinite bandwidth

83. Which of the following statement is not true for a filter with slope of -20 dB/decade?
a. It is a high pass filter√
b. Gain rolls off as frequency increases
c. If frequency is changed 10 times then gain changes by 20 dB
d. Bandwidth is limited

84. Collector current of a BJT is 10 mA. What is the transconductance of this BJT if thermal voltage is assumed to be 25 mV?
a. 40 mS
b. 0.4 mS
c. 400 mS√
d. 4 mS

85. Collector current of an inverter circuit based on BJT is 2.5 mA and collector resistance is 4 kΩ. If emitter terminal is grounded then what is the collector voltage when input signal is 5 V at the base and bias voltage is 15 V at the collector?
a. 10 V
b. 15 V
c. 5 V√
d. 0 V

86. What is the correct relationship between the collector current and base to emitter voltage of a BJT?
a. Linear
b. Quadratic
c. Exponential√
d. There is no relationship

87. Which is not the correct hybrid *h*-parameter of a BJT?
a. $h_i$
b. $h_r$
c. $h_f$
d. $h_a$√

88. Which is not the correct configuration of BJT amplifier?
a. CE
b. CC
c. CB
d. CS√

89. An *npn* transistor has base to emitter voltage 0.7 V at collector current of 1.5 mA. What is the value of reverse saturation current if thermal voltage is assumed to be 25 mV?
a. $1.037\times10^{-15}$ A√
b. $1.037\times10^{-12}$ A
c. $1.037\times10^{-18}$ A
d. Cannot be determined

90. Which is the correct name of a voltage controlled current source?
a. Transresistance Amplifier
b. Transconductance Amplifier√
c. Current Amplifier
d. Voltage Amplifier

91. Which is the correct configuration usually used in PMOS transistor's substrate terminal?
a. Substrate is connected to source
b. Substrate is connected to drain
c. The highest potential is given to substrate√
d. The lowest potential is given to substrate

92. Which defines the transfer characteristic of MOS transistor?
a. Dependence of gate current on drain-source voltage
b. Dependence of drain current on drain-source voltage
c. Dependence of drain current on gate-source voltage√
d. Dependence of gate current on gate-source voltage

93. Which one is a prohibited input combination for *R*-*S* flip-flop?
a. $R = 1, S = 1$√
b. $R = 1, S = 0$
c. $R = 0, S = 1$
d. $R = 0, S = 0$

94. How many 8:1 multiplexers are required to construct a 64:1 multiplexer?
a. 9√
b. 4
c. 8
d. 10

95. According to the IEEE Standard for Floating-Point Arithmetic (IEEE 754), how many bits are in the exponent for single precision?
    a. 2
    b. 4
    c. 8√
    d. 11
96. In which state 6 bit Johnson's counter's output will be after the $10^{th}$ clock pulse if the initial state is 000111?
    a. 011100
    b. 011111√
    c. 000111
    d. 111000
97. How many address inputs does a DRAM have with organization of 512 MB?
    a. 30
    b. 28
    c. 29√
    d. 32
98. What is the maximum memory capacity that can be addressed with 32 bits line?
    a. 3 GB
    b. 4 GB√
    c. 32 GB
    d. 2 GB
99. Which statement is true for memory?
    a. RAM is faster than cache memory
    b. RAM is cheaper than hard disk
    c. ROM can retain data in the memory even if power is switched off√
    d. ROM is faster than cache memory
100. Which statement is true for a 3-input positive CMOS NOR gate?
    a. Three PMOS are connected in parallel in the pull-up network
    b. Three NMOS are connected in series in the pull-up network
    c. Three NMOS are connected in series in the pull-down network
    d. Three NMOS are connected in parallel in the pull-down network√
101. Which sequence is correct for CMOS analog IC design process?
    a. Electrical Design → Physical Design → Testing and Product Development → Fabrication
    b. Electrical Design → Physical Design → Fabrication → Testing and Product Development√
    c. Physical Design → Electrical Design → Testing and Product Development → Fabrication
    d. Physical Design → Electrical Design → Fabrication → Testing and Product Development
102. Which type of test is the 'transient test' for CMOS analog IC design process?
    a. Functional
    b. Dynamic√
    c. Parametric
    d. Static
103. What are the sources of error in low level voltage measurements?
    a. Conductor junction voltages
    b. Drifts in voltmeter amplifier's bias voltages
    c. Thermal noise voltages
    d. All of the above√
104. What is the potential range of EEG signal?
    a. 2-20 mV
    b. 2-200 µV √
    c. 2-200 mV
    d. 2-20 µV
105. What is the range of pulse duration of cerebral potentials?
    a. 0.1-1 µs
    b. 0.1-1.5 ms
    c. 0.6-100 ms√
    d. None of the above
106. Which is the active sensor?
    a. Thermistor
    b. Resistance Temperature Detector
    c. Strain Gauge
    d. All of the above√