DEPARTMENT OF ATOMIC ENERGY

DEPARTMENTAL QUALIFYING EXAMINATION (DQE-TO-2011)

Electronics Engineering (Discipline ID : 22)

Name of the Candidate		Date of Examination	**30-7-2011**
Registration No.		Roll No.	
Signature of the Candidate		Signature of the Invigilator	

Instructions

- ❖ *This booklet consists of a question paper divided into two sections, namely **Section A** and **Section B** and blank pages for answering Section B and for rough work. **If the candidate finds any numbered page/pages missing from the booklet, he/she should immediately bring it to the notice of the invigilator and request for a replacement**.*
- ❖ *It is compulsory to attempt **both** Section A and Section B.   Total time allotted for answering **Section A is 2 Hours and for Section B is 1 Hour**.*
- ❖ *Candidates should not remove/tear-off any pages (printed or blank and also the pages utilized for rough work) from the booklet.*
- ❖ *Notations/Symbols used in the questions have their usual meaning unless stated otherwise.*
- ❖ *Non-programmable Scientific Calculators are permitted to be used.*
- ❖ *There are **60** multiple choice type questions (**1 mark each**) in **Section A**. Only one of the given options is correct. Choose only the correct option and indicate it on the OMR answer sheet provided to you separately for answering questions from Section A. Please follow the additional instructions given in the OMR answer sheet carefully before filling up. **There is no negative marking for the multiple choice type questions in Section A.***
- ❖ *At the end of 2 (two) hours, the OMR answer sheet (objective type answer sheet) must be returned to the invigilator.*
- ❖ *There are **10** questions in **Section B**. All questions carry equal marks. Answer **any Two** questions from this section on the blank pages provided in this booklet.*
- ❖ *At the end of 3 (three) hours, the entire booklet containing the printed pages, pages used by the candidate and any unused pages in full should be returned to the invigilator.*

Marks awarded in Section-A (out of 60)	Marks awarded in Section-B (out of 40)	Total Marks awarded (out of 100)	Name and Signature of the Assessor with Date

Electronics Engineering (Section - A)

(Discipline ID : 22)

Marks :   60   **Duration : 2 Hours**

Answer ALL questions.

Only one of the given options is correct. Choose only the correct option and indicate it on the OMR answer sheet provided to you separately for answering question in this Section. Please follow the additional instructions given in the OMR answer sheet carefully before filling up.

Q 1. Semiconductors have a ------------ temperature coefficient of resistance.

A) Negative   B) Positive   C) Zero   D)   Depends on operating voltage

Q 2. The forbidden energy gap of an intrinsic semiconductor ---------- with increase in temperature.

A) Does not change   B) Increases   C) Decreases   D) Increases or decreases

Q 3. Normally, p-n diodes are ------- compared to schottky diodes.

A) Faster   B) Have same speed   C) Slower   D) Can be faster or slower

Q 4. In a series resonating RLC circuit the following is true.

A) $X_L = X_C$ B) $X_L = 0$, $X_C = 0$ C) $R = X_L = X_C$ D)   None of these

Q 5. Electric field intensity due to infinite line charge, observed at any point in space is inversely proportional to

A)   Square of distance   B) Distance
C)   Cube of distance   D)   None of these

Q 6. BCD addition of   00011000   and   00100111   is

A)   00111111   B)   01001111   C) 01000101   D)   01010000

Q 7. Elements belonging to this group are used as donor impurities in semiconductor devices.

A)   Group III   B) Group V   C)   Group IV   D)   Group II

Q 8. Which of the following diode can be used for signal amplification?

A) Zener diode   B) Schottky Diode
C) Tunnel Diode   D) None of these

Q 9. A radar radiating 30W of power has a range of 10 Km, approximately how much power will be required for achieving a range of 20 Km?

A) 120W   B) 90 W   C) 60W   D) 480 W

Q 10. Mesh Analysis of circuits makes use of

A) Max power transfer   B) Kirchhoff's Current Law (KCL)
   theorem
C) Superposition theorem   D) Kirchhoff's Voltage Law (KVL)

Q 11. What is the value of 'i1' and 'i2' currents in steady state condition in the circuit shown below ?

FIG 1
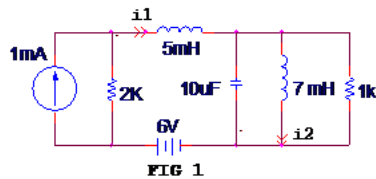
A) 4mA, 1mA   B) 3mA, 2mA
C) 4mA, 2mA   D) 4mA, 4mA

Q 12. Bootstrapping in transistor circuits is used to

A) Decrease the AC gain   B) Increase input impedance
C) Operate in class B region D) Avoid latching

Q 13. If poles and/or zeros are located in _____ of a root locus plot then the system can get unstable.

A) Right half of the s-plane   B) Left half of the s-plane

C) Bottom half of the s-plane D) Top half of the s-plane

Q 14. An ideal Operational Amplifier has following characteristics.

A) Zero offset voltage   B) Infinite slew rate

C) Zero common mode gain   D) All of these

Q 15. The input stage of a Operational Amplifier is

A) Differential amplifier   B) Common base amplifier
C) Cascode amplifier   D) Cascade amplifier

Q 16. The switch 'S1' is closed at t=0 in the circuit shown below. what is the voltage across the inductor at t=0+ and t= ∞?

A) 0V, 0V   B) 0V, 6V
C) 4V, 0V   D) none of these

Q 17. The invalid inputs to S-R Flip Flop is

A) 1,1   B) 1,0   C) 0,1   D) 0,0

Q 18. Which multivibrator can be used for digital pulse stretching?

A) Monostable B) Bistable C) Astable D) None of these

Q 19. Which of the following rectifier circuit will produce lowest ripple?

A) Three phase, half wave rectifier   B) Single phase, full wave rectifier
C) Three phase, full wave rectifier   D) Single phase, half wave rectifier

Q 20. What is the maximum permissible modulation index possible in AM?

A) 100   B) 1   C) 1.414   D) 10

Q 21. Synchronization Clock edges are used in digital circuits because

A) It is useful for counting and timing applications
B) It helps in avoiding meta-stable states in digital operation
C) It acts as a reference signal
D) It determines speed at which inputs can change

Q 22. If a microprocessor receives its highest priority interrupt and bus request simultaneously

A) Being highest priority, interrupt is serviced first

B) Bus request is serviced first as it is honored at every machine cycle boundaries

C) Interrupt is serviced first, as it is honored at instruction cycle boundaries

D) Priorities can be programmed

Q 23. In the circuit shown below R1, R2 and C1 form an attenuator and C2 is the stray shunt capacitance. Under what conditions will the circuit act as a compensated attenuator?
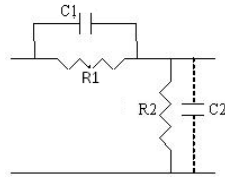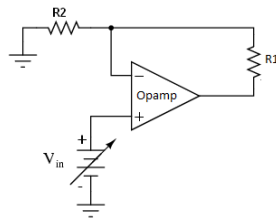

A) R1C1= R2C2   B) C1=C2

C) C1 should be absent   D) C1 should be very small

Q 24. The figure below shows the response of a C-R high pass circuit to a pulse of width t_p and amplitude V. Under which condition will the area A1= A2?
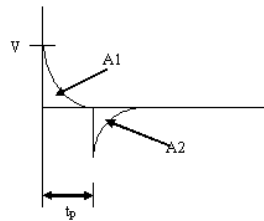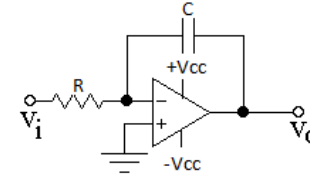

A) $RC \gg t_p$ B) $RC \ll t_p$

C) $RC = t_p$ D) The area will always be equal

Q 25. In the 'V' to 'I' converter shown in the figure below, the load resistor is:

A) R1   B) R2

C) Load must be connected between output and ground   D) Load must be connected parallel to R1

Q 26. For a step input positive voltage, the output V_0 in the circuit shown below will

A) Rise exponentially as the capacitor 'C' charges

B) Rise exponentially in the negative direction as the capacitor 'C' charges

C) Rise linearly in the positive direction as the capacitor charges

D) Rise linearly in the negative direction as the capacitor charges

Q 27. A charged particle takes a circular trajectory in a transverse magnetic field because

A) Force exerted by the magnetic field is normal to the motion at every instant

B) Charged particles have a tendency to move in circular paths

C) Charge particle does not move in circular path

D) Depends on the charge of the particle

Q 28. 'E' and 'H' arm of the magic tee shown in the figure below are
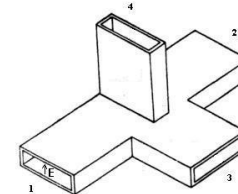
A) 4 →E arm and 3 →H arm   B) 4 → H arm and 3 →E arm

C) Both 4 and 3 are E arm   D) Both 4 and 3 are H arm

Q 29. The unlabeled block in the PLL block diagram given below is
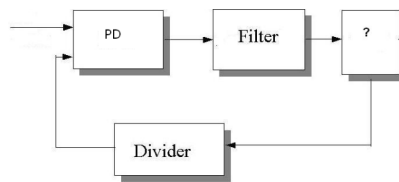
A) High pass filter   B) Rectifier

C) Demodulator   D) Voltage Controlled Oscillator

Q 30. If the voltage applied across a capacitance is triangular in waveform then the current waveform will be

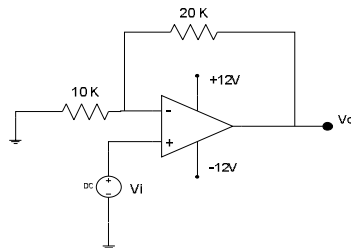A) Triangular   B) Sinusoidal

C) Square   D) Trapezoidal

Q 31. Gray code for the binary number $(111)_2$ is

A) 101   B) 100   C) 110   D) 111

Q 32. If a transmitted signal echoes back from the target to the Radar in 0.1 milli sec, what is the distance of target? (Assume c= 3×10^8 m/sec.)

A) 300 Km   B) 150 Km   C) 30 Km   D) 15 Km

Q 33. In the ideal Op-Amp circuit shown below if Vi = 5V then the output Vo will be

A) 2 V   B) -2 V

C) 15 V   D) 12 V
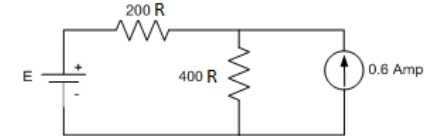
Q 34. In a Type-2 control system, the steady state error for a Parabolic input will be

A) Zero   B) Ramp   C) Constant   D) Infinity

Q35. Subtract $(1101\ 0011)_2 - (0010\ 0101)_2$

A) 1010 0010   B) 1010 1110   C) 1011 0110   D) 0111 0110

Q 36. Find out the voltage 'E' to produce a current of 0.3 Amp in the 400R resistor in the following circuit:

A) 300 V   B) 180 V

C) 120 V   D) 60 V

Q 37. If the target is approaching the Radar then the received signal frequency 'fr', will be related to transmitted signal frequency 'ft' by

A) fr = ft   B) fr > ft

C) fr < ft   D) None of the above

Q 38. CMRR of Op-Amp. should be

A) Zero   B) One   C) High   D) Low

Q 39. The maximum efficiency of Class B amplifier is

A) 25%   B) 50%   C) 100%   D) 78.5%

Q 40. A two port network having a 6 dB loss will give

A) an output voltage which is 0.707 of the input voltage

B) an output power which is 0.707 of the input power

C) an output power which is one quarter of the input power

D) an output power which is one half of the input power

Q 41. If the value of a resistor creating thermal noise is doubled then the noise power will therefore be

A) Halved   B) Quadrupled   C) Doubled   D) Unchanged

Q 42. In a 3-phase full-wave diode rectifier, if Vm is the maximum value of line to line voltage then each diode is subjected to Peak Inverse Voltage (PIV) of:

A) Vm
B) √3 Vm
C) 2 Vm
D) 3 Vm

Q 43. If the carrier of a 50% modulated AM wave is suppressed, then the percentage power saving will be:

A) 78.04
B) 33.33
C) 88.88
D) 66.66

Q 44. Which is the best electrical conductor ?

A) Silver
B) Gold
C) Copper
D) Aluminum

Q 45. Cyclo-converters are used for

A) AC to DC conversion
B) AC to AC conversion
C) DC to AC conversion
D) DC to DC conversion

Q 46. Lag compensator is a

A) Band Pass Filter
B) Band Reject Filter
C) High Pass Filter
D) Low Pass Filter

Q 47. If two 200W bulbs of constant resistance are connected in series then the total power consumption will be

A) 400 W
B) 100 W
C) 200 W
D) 300 W

Q 48. In a thyristor, holding current is

A) More than latching current
B) Less than latching current
C) Equal to latching current
D) un-correlated to latching current

Q 49. Convert the binary number $(1011.1011)_2$ into decimal number system.

A) 11.6875
B) 11.675
C) 13.8125
D) 13.6875

Q 50. Which amplifier is mostly used in SSB transmitter?

A) Class B amplifier
B) Class C amplifier
C) Tuned modulator
D) Class A amplifier

Q 51. The difference between frequency and phase modulation :

A) Is that the frequency modulation needs more bandwidth for same signal
B) Lies in the poorer audio response of phase modulation
C) Lies in different definitions of the modulation index
D) Is too large to make the two system look compatible

Q 56. Which Logic family has the lowest propagation delay time?

A) ECL
B) TTL
C) CMOS
D) PMOS

Q 53. What is the length of IPv6 address?

A) 32 bits
B) 64 bits
C) 128 bits
D) 256 bits

Q 54. How many minimum address lines are required to interface two 8K RAMs to an 8 bit microprocessor?

A) 12
B) 13
C) 14
D) 15

Q 55. When electromagnetic waves are propagated in a waveguide:

A) They travel along the broader walls of the guide
B) They are reflected from the walls but do not travel along them
C) They travel through the dielectric without touching the walls
D) They travel along all four walls of the waveguide

Q 56. The TWT is sometimes preferred to the multicavity klystron amplifier, because :

A) TWT Is more efficient
B) TWT has a greater bandwidth
C) TWT has a higher number of modes
D) TWT produces a higher output power

Q 57. The use of liquid crystal for display application is possible because of its following optical properties:

A) Reflection
B) Change in polarisation
C) Diffraction
D) Birefringence

Q 58. A geostationary satellite:

A) is motionless in space (except for its spin).
B) is not really stationary at all, but orbits the Earth with a period equal to earth rotation on its axis
C) appears stationary over the Earth's magnetic pole
D) is located at a height of 35,800 Km to ensure global coverage

Q 59. For a switching DC-DC convertor with 24V to 30V input and 5V output, which is the most

A) Boost convertor
B) Buck convertor
C) Boost-Buck convertor
D) Full bridge inverter

Q 60. Induction motor working with 50Hz AC commercial power supply will have a _____ power factor.

A) Unity   B) Leading   C) Lagging   D) Zero

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Electronics Engineering (Section - B)

(Discipline ID : 22)

Marks : 40   **Duration : 1 Hour**

All questions carry equal marks. Answer any **Two** questions from this section on the blank pages provided in this booklet.

Q.1   a)   Explain and draw the volt-ampere (V-I) characteristics of a semiconductor P-N junction diode with all important parameters marked on it. What is effect of temperature on V-I characteristics of diode? Explain reverse breakdown in diodes.

       b)   Draw a zener regulator and explain its principle of working. Design a zener regulator circuit to provide 5V dc to a load with maximum current of 10mA. Input voltage varies from 8V to 9V. Determine the specifications of zener and the resistances used in the circuit.

Q.2   Draw an astable multivibrator using an Op-Amp and explain its principle of working with the help of waveforms at various nodes in the circuit. Derive the expression for the period of the astable. Design an astable multivibrator using an Op-Amp circuit for 10 KHz output frequency taking 50% feedback from the output.

Q.3   Explain with circuit diagram, how Operational Amplifier can be used as an Integrator and derive its output expression. How does the step response of this integrator differ from that of passive RC integrator? If a symmetrical square wave signal (zero centered and 50% duty cycle) of frequency 10 KHz drives the above integrator with a peak to peak voltage of 10V then what is the peak to peak output voltage. Assume R_i = 1Kohm, C_f = 1 microfarad and R_f = 100Kohm. Also draw the input and output waveforms of this integrator. (Assume no initial charge on capacitor C_f and output saturation voltage as $\pm$ 12V)

Q.4   Derive an expression of current in a series RLC circuit excited by a step voltage input in series. Show the types of response plots. In the above circuit, if inductor L is 4H and capacitor C is 0.125 F ; what should be the value of resistor R for critically damped step response.

Q.5   a)   Define root locus and explain how the stability can be determined using root locus for a closed loop control system.

b) Consider open loop transfer function G(s) = K/{(s+1)(2s+1)(4s+1)}.
Show the Nyquist Plot shape indicating important points on the plot, for this transfer function for values of K=1 and K=45 respectively. Hence determine the stability of this closed loop system with unity feedback for the two cases of gains using Nyquist criterion. Also determine the gain margins in these two cases and comment.

Q.6 Explain operation of JK flip flop with the help of truth table. How race around condition is avoided? How a symmetrical digital clock of 500 KHz can be derived from an asymmetrical digital clock of 3 MHz using JK type of flip-flops (with necessary combinatorial logic)? Explain the functioning with the help of timing diagrams and truth table.

Q.7 a) Write the truth table of a full adder. Draw the logic circuit of a 3-input full adder using two half adders.

b) Draw an encoding Diode-Matrix (BCD encoder), to convert a decimal number into a binary code.

Q.8 a) Explain Kirchoff's Voltage Law and Kirchoff's Current Law. How are these Laws used in circuit analysis?

b) i) A step input of 10V is applied to a series circuit of 50 µF capacitor and a resistor. If the voltage across the capacitor is observed to be at 5V at t =2sec, determine the value of series resistance in the circuit.

ii) A rectangular pulse of 10V amplitude and 2.5 µsec duration is applied to a series RL circuit using R =2Ω and L =5 µH. Plot the current waveform in the circuit.

Q.9 a) Explain the characteristics of conductor, semiconductor and insulator using energy band diagrams.

b) A semiconductor has electron concentration 4.5×10^5 cm^{-3} and hole concentration 5×10^{14} cm^{-3}. Find its conductivity. (Assume electron mobility = 1350 cm^2 V^{-1}s^{-1} and hole mobility 450 cm^{2}V^{-1}s^{-1}).

Q. 10 a) Explain the operation of a summing amplifier using an Operational Amplifier. Show how 0.4 to 2 VDC signal can be translated to 0 to +10V by employing summing and inverting amplifier.

b) A transmission line of 72 ohm is connected to a 100 ohm load. Find

   i) Standing Wave ratio due to this mismatch

   ii) Reflection coefficient

   iii) Ratio of the reflected and incident power at the load

   iv) Percentage of the incident power absorbed in the load

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