

P.A.H. Solapur University, Solapur
School of Physical Sciences
M. Sc.-I, SEM. II, Electronic Science
HCT 2.2 Digital Signal Processing
Question Bank

Q.1. Answer the following.

(4 marks)

1. Derive the DFT expression from the DTFT.
2. What is DSP? Give its advantages and applications.
3. Explain the concept of quantization
4. List any four properties of Z-Transform.
5. Find Z transform of $x(n)=\{1,2,3,4\}$
6. Obtain the discrete Fourier series coefficients of $x(n)=\cos \omega_0 n$.
7. Write a note on Aliasing effect.
8. What are the various methods to design IIR filters?
9. What is impulse invariant transformation?
10. What are the properties of FIR filter?
11. What is DFT? State Linearity property of DFT.
12. What are the applications of FFT algorithms?
13. What are the different methods of evaluating inverse z-transform?
14. What are the properties of convolution?
15. What are the standard discrete time signals?
16. Define the term:
 - i) time variant and time invariant system
 - ii) recursive and non recursive system
17. Test the stability of given systems.
 - i) $y(n)=\cos(x(n))$
 - ii) $y(n)=x(-n-2)$
18. Prove the frequency shifting theorems of the DTFT.
19. State the condition for a digital filter to be causal and stable.

20. What are the desirable characteristics of the frequency response of window function?

17. Use concentric circle or graphical method to find the circular convolution of $x(n) = \{1, 3, 5, 3\}$ and $h(n) = \{2, 3, 1, 1\}$.

Q.2. Answer the following.

(8 marks)

1. Check whether the following are periodic

i) $X(n) = \cos(3\pi n)$ ii) $X(n) = \sin(3n)$

2. Explain the classification of discrete systems.

3. Explain neatly about the operations performed on a signal

4. Determine whether the system is linear, time invariant, memory less and causal

$$Y(n) = x(n^2)$$

5. Check the causality and stability of the systems $y(n) = x(-n) + x(n-2) + x(2n-1)$

6. Check the system for linearity and time invariance $y(n) = (n-1)x^2(n) + c$.

7. Explain in detail reconstruction of analog signal.

8. Determine the Z transform of..

(1) $x(n) = a^n \cos \omega_0 n u(n)$

(2) $x(n) = 3^n u(n)$

9. Explain the properties of Z-transform.

10. Find the impulse response given by difference equation.

$$y(n) - 3y(n-1) - 4y(n-2) = x(n) + 2x(n-1)$$

11. Find the convolution.

$$x(n) = \{-1, 1, 2, -2\}, \quad h(n) = \{0.5, 1, -1, 2, 0.75\}$$

12. Find the z-transform and ROC of

$$X[n] = r^n \cos(n\theta) u[n]$$

13. . Find Inverse z-transform of

$$X(Z) = \frac{z}{(3z^2 - 4z + 1)} \\ \text{ROC } |z| > 1$$

14. Explain neatly with proof the properties of DTFT

15. Using FFT algorithm, compute the DFT of $x(n) = \{2, 2, 2, 2, 1, 1, 1, 1\}$

16. Obtain the 8 point DFT using DIT - FFT algorithm for $x[n] = \{1, 1, 1, 1, 1, 1, 1, 1\}$

17. Explain in detail DFT of long duration sequence by overlap-save method.

18. Explain in detail DFT of long duration sequence by overlap-add method.

19. Obtain cascade and parallel realization for the system having difference equation.

$$y(n) + 0.1y(n-1) - 0.2y(n-2) = 3x(n) + 3.6x(n-1) + 0.6x(n-2)$$

20. . Explain Frequency sampling method of designing FIR filter.

21. What are the drawback in FIR filter design using windows and frequency sampling method? How it is overcome?

22. Explain Bilinear Transformation method of design of IIR filter in detail.

23. Determine the Discrete Fourier transform $x(n) = (1, 1, 1, 1)$

24. Obtain the Direct form II

$$y(n) = -0.1(n-1) + 0.72 y(n-2) + 0.7x(n) - 0.252 x(n-2)$$

25. Find the direct form II

$$H(z) = \frac{8z^2 + 5z - 1}{7z^3 + 8z^2 + 1}$$

26. Find the Z transform of ...

$$\text{i) } x(n) = \left[\left(\frac{1}{2}\right)^n - \left(\frac{1}{4}\right)^n \right] u(n)$$

$$\text{ii) } x(n) = n(-1)^n u(n)$$

$$\text{iii) } x(n) = (-1)^n \cos(\pi n/3) u(n)$$

$$\text{iv) } x(n) = \left(\frac{1}{2}\right)^n u(n-2) + 8(n-5)$$

27. Find the Z transform of the following sequence and ROC and sketch the pole zero diagram

$$\text{i) } x(n) = a^n u(n) + b^n u(n) + c^n u(-n-1), \quad |a| < |b| < |c|$$

ii) $x(n) = n^2 \text{ and } u(n)$

28. What are the advantages of DSP over analog signal processing?

29. Explain successive approximation technique.

30. Explain the sample and hold circuit.

31. A causal LTI system has impulse response $h(n)$ for which Z transform is given by

$$H(z) = 1 + z^{-1} / (1 - 1/2 z^{-1}) (1 + 1/4 z^{-1}).$$

i) What is the ROC of $H(z)$? Is the system stable?

32. Deduct whether the following systems are linear time invariant

(i) $y(n) = A + Bx(n)$

(ii) $Y(n) = ex(n)$

33. Test the stability and causality of the following system :

$$y(n) = \cos x(n)$$

34. Explain in detail circular convolution methods.

35. Check whether the given systems are linear, shift variant, causal and stable

a. $y[n] = x[4n+1]$, b. $y[n] = x[n]u[n]$, c. $y[n] = x[n] + nx[n+1]$

36. Explain with a suitable example the steps for design of linear phase filters using hamming window

37. Explain discrete time signals classifications.

38. Explain relationship between Z-transform and ROC.

39. Explain how linear convolution is obtained from Circular convolution.

40. Explain the Radix 2 DIF - FFT algorithm for 8 point DFT

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HCT – 2.1: Control Systems
Question Bank

Q.1. Answer the following.

(4 marks)

1. Explain the effect of feedback on control system.
2. Compare: open loop and closed loop system.
3. What is the main significance of root locus?
4. Write a note on Mason's gain formula.
5. What are the basic elements used for modeling mechanical translational and rotational system?
6. Explain the terms utilized in signal flow graph.
7. What is stability? State its different types.
8. Explain Angle and magnitude condition for stable systems.
9. What is transfer function? How the order of control system is calculated?
10. What is Bode Plot?
11. What are frequency response specifications?
12. What are time domain specifications?
13. Define Laplace transforms? What are the Laplace transform of standard test signal?
14. Describe briefly state space analysis.
15. Mention the advantages and disadvantages of proportional controller.
16. Explain in brief on-off controller.
17. Derive an expression for transfer function of lead compensator.
18. Distinguish between PI and PD controller.
19. Define terms:
 - i) State
 - ii) State vector
 - iii) Sink node
 - iv) Non touching loops
20. Discuss stability analysis using Hurwitz's criterion

Q.2. Answer the following.

(8 marks)

- Using Routh's criterion check the stability of a system whose characteristic equation is given by.

$$S^6 + S^5 - 2S^4 - 3S^3 - 7S^2 - 4S - 4 = 0$$

- Explain the stability of given equation using Hurwitz method.

$$7S^3 + 5S^2 + 4S + 9 = 0$$

- Consider the system with $G(S)$. $H(S) = K/S(S+2)(S+4)$ and $S = -0.75$ is confirmed to be on the root locus. Determine at what value of k , $S = -0.75$ is one of the roots of $1+G(s).H(s)$. Use magnitude condition.
- Explain in detail the state space representation for n^{th} order differential equation.
- Explain state model from transfer function using parallel method.
- What is tachogenerators? Draw and explain the working of DC and AC tachogenerators and represent in block diagram form.
- What is control system? What are the various types of control system? Explain them in brief.
- Derive an expression for the time response of first order system to unit step input.
- What is transfer function? Derive an expression for it.
- Find the gain of the system represented by the following equations.

$$x_2 = a_{22} x_1 + a_{32} x_3$$

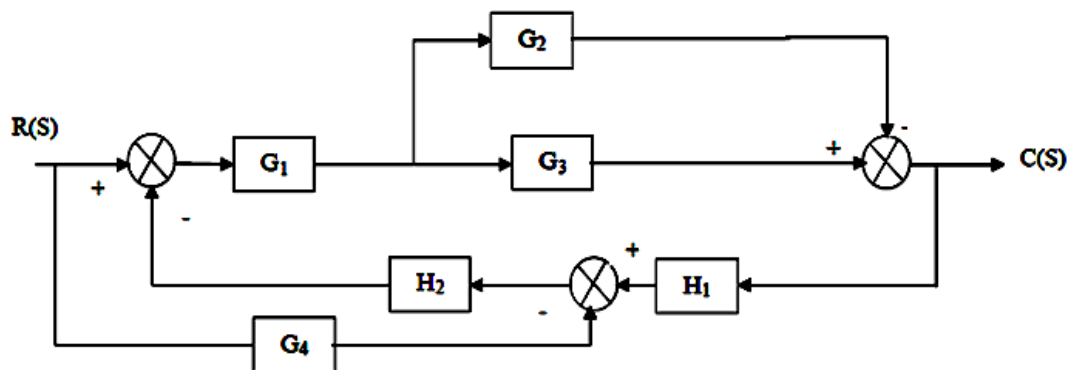
$$x_3 = a_{23} x_2 + a_{34} x_4$$

$$x_4 = a_{24} x_2 + a_{34} x_3 + a_{44} x_4$$

$$x_5 = a_{25} x_2 + a_{45} x_4$$

Here, the input node is x_1 and output node is x_5 .

- Explain linear mathematical physical system, obtain its transfer function and represent it in block diagram form.
- Explain block diagram reduction rules? Reduce the following diagram and obtain its transfer function.



13. Derive an expression for transfer function of the following compensator networks:

i) Lead compensator

ii) Lag compensator

14. What is root locus? Obtain the roots locus for given equation $G(S).H(S) = K/S$. consider the feedback system is unity.

15. Obtain gain margin and phase margin for the open loop transfer function using Bode plot.

$$G(s).H(s) = 80/s (1+s/50) (1+s/20).$$

16. Explain in detail the types and order of control system.

17. Design and explain a PI controller. Mention its advantages and disadvantages?

18. Draw and explain the working of potentiometer error detector and represent in block diagram form.

19. Explain in detail the state model from transfer function using direct method.

20. Draw a block diagram of closed loop system and obtain an expression for its transfer function.

21. Explain the time response of second order system subject to unit step input for the following cases:

i) under-damped

ii) critically damped

22. Explain the state space representation for the following:

i) Electrical Network

ii) n^{th} order differential equation

23. Determine the stability of a given characteristic equation by Routh's method:

$$F(s) = S^3 + 6S^2 + 11S + 6 = 0 \text{ is characteristic equation.}$$

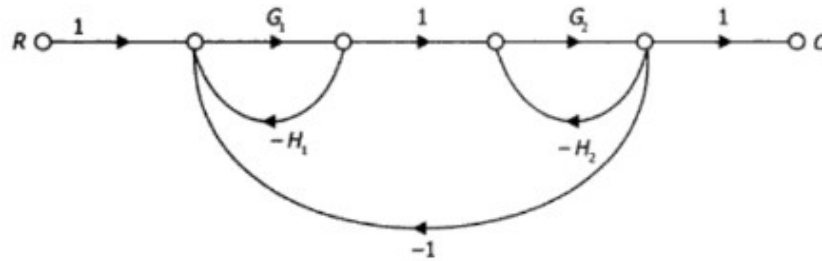
24. Draw and explain RLC circuit and obtain its transfer function.

25. Explain the design of gear trains with its transfer function and draw its block diagram.

26. Derive the expressions and draw the response of first order system for unit step input.

27. What is root locus? Consider the system with $G(s).H(s) = K/S(S+2) (S+4)$. Find whether $S = -0.85 + j.6$ is on root locus or not using angle condition.

28. Find the gain of the system represented by the following signal flow graph.

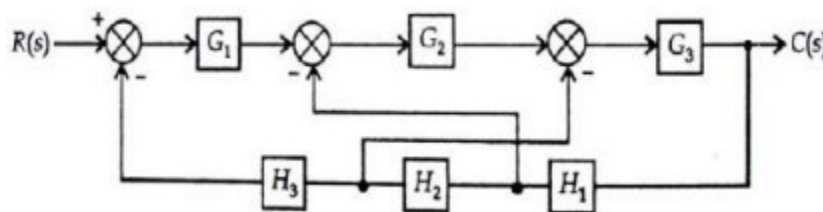


29. Sketch Bode plot for the transfer function.

$$200(S+2)/S(S^2+10s+100)$$

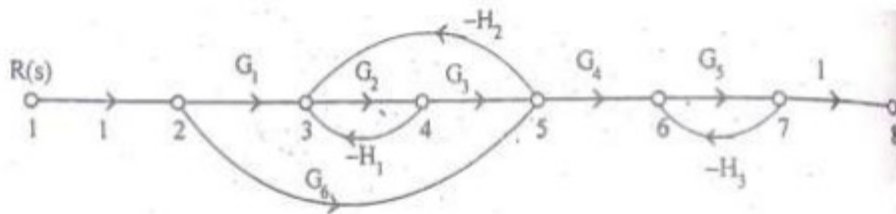
Determine there from gain margin and phase margin.

30. Determine close loop transfer function of the system shown below using block diagram reduction techniques.



31. What is steady state error? Derive an expression for it.

32. Find the overall transfer function of the system whose signal flow graph is shown below.



33. Sketch the root locus of the system whose open loop transfer function is

$$G(s)H(s) = K(S+2)(S+4).$$

34. Derive the expressions for resonant peak and resonant frequency and hence establish the correlation between time response and frequency response.

35. Define Stability. With an example explain the steps to be followed for Routh - Hurwitz criterion.

36. State and explain the effects of P, PI and PID controller on the system dynamics.

37. Derive an expression to find steady state error of a closed loop control system.

38. Explain the procedure for constructing root locus.

39. Write a note on:

i) signal flow graph ii) Mason's gain formula

40. Explain in detail concept of poles and zero.

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SCT 2.1- Advanced Microcontrollers and Protocols
Question Bank

4 marks questions

1. What are the types of CORTEX-M series ?
2. How do you select a specific CORTEX-M processor ?
3. What is Trustzone System IP block ?
4. What is the use of T604 ? Have you used it ?
5. Have you come across LINARO ? Have you been involved in LINARO ?
6. What is pipeline shutdown ?
7. what are the kinds of protection available for SRAMS ?
How to use the single bit or double bit fault correction ?
8. What is interrupt pipelining ?
9. Explain the architecture of the CORTEX series ARM that you have used .
10. What is the use of the AMBA interface and where is it present in the architecture ?
11. What is branch prediction ?
12. What is out of order execution ? Have you considered it in selection of processor ?
13. If the pipeline is wider , the instruction throughput is high – True/False ?
14. What is the use of Neon Floating point engine ?
15. In what scenarios can neon do better than normal core ?
16. Is power dissipation more in neon compared to normal core ?
17. Incase of multimedia applications, what is the approximate number of times by which the throughput
is increased compared to normal core ?
18. Is Neon available with Cortex M or Cortex A series ?
19. Have you used RVDS ? Have you used gcc arm toolchain ? Which of these two tools is better ?
20. What is the use of –vectorizeoption ?
21. Have you used Palladium emulator ? Is it JTAG based ?
22. Have you used XDS510 emulator ?
23. What is Coresight System Trace Macrocell(STM) ?
24. What is the difference between ‘intrusive trace’ and ‘non-intrusive trace’ mechanisms ?
25. Which of the following is intrusive – printf, lttng, strace, ftrace, ltrace ?
26. Can you explain the flow from User application and the role of STM driver ?
27. What are the advantages and disadvantages of LTTng ?
28. What is hardware assisted instrumentation ?
29. What is the advantage of hardware assisted instrumentation over software instrumentation ?

30. What is PTM ?
31. What is TPIU ?
32. What is ITM ?
33. What is ETM ?
34. Low latency instrumentation is required for ISR tracing, Bootcodetracing . How is low latency tracing achieved ?
35. STM cannot trace instructions. It traces only system level calls – True / False.
36. ETM is for data/program instructions & for cache/DMA level instructions – True / False.
37. In Kinetis, can SRAM be configured to act as either NVRAM or EEPROM ? Have you configured or tried it ?
38. How many power modes are there in Kinetis ? Can you tell the wakeup/recovery time for every mode ?
Which mode has the fastest recovery time ? Which mode has the lowest current consumption ?
39. Cortex M4 has Run , Sleep and Deep sleep modes – True / False ?
40. Is 32-pin Cortex M4 compatible with 256 pin Cortex M4 processor ?
41. What is I2S interface ?
42. What are the features of Cortex M4 ?
43. Tell about the Exception Handling in ARM processor. What does the ARM Core do automatically for every exception ?
44. Can you tell about DSP in ARM7TDMI or DSP in STRONGARM or DSP in ARM9E ?
45. Why should you design the DSP algorithm in general ARM architecture so that saturation is not required ?
46. Tell about AIF(Arm Image Format) and AOF(Arm Object Format) ?
47. What are the Memory initialization directives ?
48. What is the use of 'SWI' in ARM assembly ?
49. How to Represent a Digital Signal in ARM ?
50. Give Example of STMFD w.r.t Stack Operation push/pop ?
51. Tell about Extended Multiply Instructions in ARM
52. Tell about the NORMAL Multiply Instructions in ARM
53. Tell about ADR's relation with LDR and the Advantage of using LDR together with '=' ?
54. When does the Processor Stall in ARM and what is the pipeline hazard in ARM?
55. What is called 'pipeline bubble' in ARM ?
56. What is Saturating Arithmetic ? Explain
57. Tell the 2 software methods available to remove interlocks following load instructions
58. Tell about 'Load Scheduling By Preloading' and 'Load Scheduling by unrolling' ?
59. How will you flush the instuction Cache in ARM processor ?
60. List the issues when porting C code to the ARM processor ?
61. What are the advantages of writing in Assembly in ARM processor?
62. Explain this -> "AREA |.text|, CODE, READONLY"
63. What is the use of the 'EXPORT' directive ?
64. What is the use of various directives ?
65. How to build using command line tools w.r.t ARM ?
66. Write a simple square.s program in ARM assembly called from a C file ?

67. What will you change that program when calling ARM code from C compiled as Thumb ?
68. How will you allow Thumb C code to call the ARM assembly Code ?
69. What is the use of 'RN' directive in ARM assembly ?
70. What imports the libraries like printf automatically in the assembly side of ARM ?
71. What is the DCB directive and its relation with strings ?
72. What is ARMulator ? Where and How have you used it ?
73. How will you handle the Register Shortage problem in ARM ?
74. Relation between CPSR flags, S Suffix Instructions and Comparison Instructions ?
75. What is Conditional Execution in ARM ?
76. What is single issue multiple data (SIMD) processing ?
77. What is a Coprocessor / CP15 in ARM ?
78. What does the 'B' mean in LDRB or What is the difference between LDR and LDRB in ARM ?
79. What is the use of Write-Back ?
80. When should i use '!' in ARM programming and where is it Not Allowed to be used in ARM programming ?
81. Tell about 'Single Data Transfer' and 'Multiple Data Transfer' in ARM
82. How will you manually Enable / Disable an interrupt in ARM Processor ?
83. Tell about MRS and MSR instructions ?
84. Can you tell a 32-bit branch instruction and the way you used it ?
85. When have you used Thumb instructions in ARM processor ?
86. Write a program to mask bytes in ARM assembly ?
87. ARM7 family of processors does not use any branch prediction scheme. Neither ARM9 nor ARM9E family implements branch prediction – True / False
88. The ARM11 micro-architecture uses two techniques to predict branches – True / False
89. What is Translation Lookaside Buffer (TLB) ?
90. What are the types of addressing modes in ARM ?
91. Can you brief up the evolution of ARM architecture ?
92. Why ARM7TDMI alone highlights the features that it supports in its naming and why not other ARM architectures ?
93. When will you choose to use ARM and when will you choose to use Thumb instructions ?
94. Can you explain the operation of ARM7 pipeline for simple instructions ?
95. Can you tell about function performed by this instruction – ADD r3, r5, r12 ?

8 MARKS Questions

1. Explain ARM Architecture in details
2. Explain Data Types, Processor modes, Registers, General Purpose Registers, Program Status Register in ARM
3. Explain Exceptions, Interrupts and Vector table in arm

4. Interface the 8 led to ARM & Write embedded C programme to turn on LED in Running mode
5. Interface the two switches to ARM& Write embedded C programme to detect switch action and on and off the LED
6. Explain I2C protocol in detail
7. Explain SPI protocol in detail
8. Explain CAN protocol in detail
9. Explain ARM Cortex-M0 to M3 in details
10. Explain data transfer instructions in ARM
11. Explain Arithmetic instructions in ARM
12. Explain Logical instructions in ARM
13. Explain program flow control instructions in ARM
14. What is ST-link driver and explain OpenST32
15. Explain Cube-MX,Keil-5 pack

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OET 2.1 Fundamental of Electronics

Question Bank

Each question having four marks.

- 1) A certain soldering iron has a resistance of 600 ohms when operated from a 230 volts power line. How much current does it take from the power line?
- 2) Calculate the energy used (in kWh) to run twelve 150 W light bulb for ten hours?
- 3) State and Explain Thevenin's theorem?
- 4) State and explain Kirchhoff's current law?
- 5) Discuss briefly the Kirchhoff's voltage law?
- 6) Define the term i) Cycle ii) time period
- 7) Explain the difference phase and phase term?
- 8) What is meant by intrinsic semiconductor?
- 9) Explain what is Hole in Brief?
- 10) What is PN junction Diode? Explain it?
- 11) What are the important application of diode?
- 12) What is ideal diode and real diode?
- 13) What is Zener diode? Draw circuit diagram?
- 14) Define the term Common mode rejection ratio?
- 15) What is differential amplifier? Can be used in single ended input configuration?
- 16) Describe the block diagram of op-amp?
- 17) What is voltage Follower?
- 18) Explain switching action of a transistor?
- 19) Draw the switching waveform for the astable multivibrator?
- 20) Explain operation of an astable multivibrator?

Each question having eight marks

- 1) What is nonsinusoidal oscillator? Explain it briefly?
- 2) Draw a circuit of astable multivibrator and explain its working?
- 3) Sketch a transistor Schmitt trigger circuit and briefly explain its operation giving input output waveform?
- 4) Draw an internal operational circuit of timer IC 555?
- 5) Explain the operation of a bistable multivibrator?
- 6) Distinguish between a bistable and monostable multivibrator?
- 7) Discuss the principle of transistors bistable multivibrator?
- 8) What is multivibrator? Explain the difference between the three types of multivibrators?
- 9) Explain in details of switching action of a transistor?
- 10) What is essential difference between direct current and alternating current?
- 11) State and explain the three version of ohms's law relating voltage, current and resistance?
- 12) Briefly define each of the following, giving its unit and symbol: Charge, Potential, Potential difference, Current resistance and Conductance?

- 13) What is maximum power transfer theorem? Show that power lost in the internal resistance of a source is equal to the power delivered to the load the power efficiency is only 50%?
- 14) Explain briefly the following;
 - i) Linear resistor
 - ii) Non-linear resistor
- 15) What is capacitor? Give its three application?
- 16) Write a short note on a variable capacitor?
- 17) What is difference between an ideal current source and a practical current source?
- 18) Draw V-I characteristics of a junction diode when it's a) forward biased b) reverse biased
- 19) Briefly explain (without derivation) the behaviour of junction in forward bias and reverse bias mode and draw its volt-ampere characteristics?
- 20) What is PN junction diode? How its terminal are identified?
- 21) In What respect is an LED different from an ordinary PN junction diode? State application of LEDs.
- 22) Explain with the help of neat diagrams, the structure of a N-channel FET, and its volt-ampere characteristic. In what way it is different from a bipolar junction transistors?
- 23) Distinguish between FET and BJT?
- 24) Describe some of the characteristics of a practical op-amp?
- 25) What is voltage followers? Describe its main characteristics?
- 26) Explain in details of instrumentation amplifier?
- 27) Distinguish between operation amplifier and Instrumentation Amplifier?
- 28) Explain in details ideal characteristics of op-amp?
- 29) Explain comparator Schmitt trigger wave generator (Square wave and Triangular wave)?
- 30) Discuss the term in details of DC and AC characteristics of op-amp?
- 31) Define the term a) LED b) Solar Cell c) Photodiode
- 32) Explain in details first order low pass and high pass filter?
- 33) Discuss V to I and I to V converter precision rectifier?
- 34) Explain the effect of temperature on the volt-ampere characteristic of diode?
- 35) Draw a block diagram of IC 555 and explain in details?
- 36) Explain the application of network laws to simple dc network?
- 37) Distinguish between monostable and astable multivibrators?
- 38) **Why the Reset pin of IC 555 is normally connected to Vcc, and why the control voltage (pin 5) of 555 timers is connected to ground through a 0.01 μ f capacitor?**
- 39) **Explain in details p-n junction with terms of unbiased and biased junctions?**
- 40) **How PN junction diode is working? Draw and explain V-I characteristic of PN diode with neat diagram?**