

13/05/2025 SE EXTC SEM-IV C-SCHEME EM-IV QP CODE: 10082322

(3 Hours)

[Total Marks: 80]

N.B. : 1) Question No. 1 is **Compulsory**.2) Answer **any THREE** questions from Q.2 to Q.6.

3) Figures to the right indicate full marks.

Q.1 (a) Evaluate $\int z dz$ where c is unit circle $|z| = 1$ (5)(b) Find a unit vector orthogonal to both $u = (1,1,1)$ and $v = (1,1,0)$. (5)

(c) Calculate Karl Pearson's coefficient of correlation from the following data. (5)

Price (in \$)	5	6	3	4	3
Deman (in units)	10	10	12	11	12

(d) Find k and mean of following distribution. (5)

X	8	12	16	20	24
P(X=x)	1/8	k	3/8	1/4	1/12

Q.2 (a) Find the extremals of $\int_{x_1}^{x_2} (1 + x^2 y') y' dx$. (6)(b) For Normally distributed variate X , with mean 1 and S.D. 3, (6)Find i) $P(3.43 \leq X \leq 6.19)$. ii) $P(-1.43 \leq X \leq 2.3)$.(c) Find Laurent's series of $f(z) = \frac{2z-3}{(z-1)(z-3)}$ about $z = 0$. (8)Q.3 (a) A continuous r.v. X has a P.D.F. $f(x) = ke^{-x}x^2, x \geq 0$ find k and mean. (6)(b) Evaluate $I = \int_C \frac{z^2+4}{(z-2)(z+3i)} dz$ where c is $|z-2| = 2$. (6)

(c) Reduce the following quadratic form into canonical form and hence find its rank, index and signature. (8)

$$Q = 2x_1^2 + x_2^2 - 3x_3^2 + 12x_1x_2 - 8x_2x_3 - 4x_3x_1.$$

- Q.4 (a) Fit a straight line for following data. (6)

X	0	1	2	3	4
y	1	1.8	3.3	4.5	6.3

- (b) Show that any plane through origin is a subspace of R^3 . (6)

- (c) Using Rayleigh-Ritz method, solve boundary value problem

$$\int_0^1 \left[xy + \frac{(y')^2}{2} \right] dx, \quad 0 \leq x \leq 1, \quad \text{with } y(0) = 0 \text{ and } y(1) = 0. \quad (8)$$

- Q.5 (a) Given $6y = 5x + 90$, $15x = 8y + 130$. Find (i) \bar{x} and \bar{y} (ii) r (6)

- (b) Find an orthonormal basis for the subspace of R^3 by applying Gram-Schmidt process where $S = \{(1, 1, 1), (2, 1, 0), (5, 1, 3)\}$. (6)

- (c) Find the singular value decomposition of $A = \begin{bmatrix} 4 & 4 \\ -3 & 3 \end{bmatrix}$. (8)

- Q.6 (a) Verify Cauchy-Schwartz's inequality for $\{u = (2, 1, -3), v = (3, 4, -2)\}$ (6)

- (b) Find the probability that at most 4 defective bulbs will be found in a box of 200 bulbs if it is known that 2% of the bulbs are defective. (6)

- (c) Calculate Spearman's coefficient of rank correlation from the following data. (8)

X	10	12	18	18	15	40
Y	12	18	25	25	50	25

Time: 3 hours

Total Marks: 80

N.B.:

- 1) Question No.1 is compulsory
- 2) Solve any three from remaining five.
- 3) Figures to right indicate full marks.

Q. 1 Attempt any four questions.

- A) Write short note on Inverting ZCD with input-output waveforms. [5]
- B) Define the following parameters with values of an operational amplifier 741.
 - i) CMRR ii) Virtual Ground iii) Output Offset Voltage
 - iv) Unity Gain Bandwidth v) Slew Rate [5]
- C) Compare Inverting and Non-Inverting comparator. [5]
- D) Write note on grounded load type voltage to current converter. [5]
- E) Explain the functional block diagram of IC 555. [5]

Q. 2 A) Draw the circuit diagram of op-amp based differentiator and derive the expression for output voltage. Enlist the limitations of ideal differentiator and how they are overcome in practical differentiator. [10]

B) Explain the operation of Non-inverting Schmitt Trigger. Draw the input- output waveforms along with transfer characteristics. Find the expression for hysteresis voltage for it. [10]

Q. 3 A) Draw and explain working of RC-phase shift Oscillator and derive the expression for output frequency. [10]

B) What are the advantages of precision rectifiers? Explain in detail Full-wave precision rectifier with neat waveforms and waveforms. [10]

Q. 4 A) Explain the Astable Multivibrator using IC 555. Derive the expression for duty cycle and Output frequency. Draw the waveforms. [10]

B) Design a high pass second order Butterworth filter for the cut off frequency of 1kHz and Passband gain $A_f = 2$. [10]

Q. 5 A) What is an Instrumentation Amplifier. Draw a neat diagram of three-op-amp I. A. Derive its output voltage equation. [10]

B) Design a voltage regulator with $V_o = 10$ Volts and $I_L = 100$ mA. Short circuit Protection is to be provided at $I_L = 150$ mA. Assume V_{Sense} to be 0.65 volts. Use IC LM 723. [10]

Q. 6 Write short notes on: (Attempt any four)

- A) Phase Locked Loop (PLL) [5]
- B) Compare Linear regulators with switching mode regulators [5]
- C) Three Terminal Voltage regulators [5]
- D) Difference amplifier [5]
- E) Positive Peak detector circuit [5]

Duration: 3hrs

Max Marks:80

- N.B. :** (1) Question No 1 is Compulsory.
 (2) Attempt any three questions out of the remaining five.
 (3) All questions carry equal marks.
 (4) Assume suitable data, if required and state it clearly.

- 1 Attempt any FOUR [20]
- a What does **ARM** stand for in technology? 5
- b What are the steps involved in executing instructions in a microprocessor from memory? 5
- c List the features of NXP89v51RD2. 5
- d In what scenarios is secondary memory preferred over primary memory? 5
- e If the value of TMOD register is 4CH then write status of timer use in 8051 microcontroller. 5
- 2 a Differentiate between segmentation and paging in concern with the memory system. [10]
- b Write a program to add 0AH, 0BH data and store 8 bit result in memory location 10H and status of result in 11H memory location. [10]
- 3 a Display Character "A" serially using mode1 with baud rate 9600, using 8051 microcontroller. Draw format of SCON register. [10]
- b Explain following instruction of ARM7 [10]
1. MVN R0, 0x25H 2. SUB R0,R1,#0x12H
- 4 a How do you choose the right microcontroller for a given application? [10]
- b Which register is used to access stack memory? Explain stack structure of 8051. [10]
- 5 a What is the size of registers in ARM7? Explain the register model of ARM7. [10]
- b Write a program to find a large number among 10 numbers using 8051 microcontroller. [10]
- 6 a Explain the internal and external memory architecture of the 8051 microcontroller [10]
- b Explain port0 and port3 structure of 8051 microcontroller. [10]

Duration: 3hrs

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- 1 Attempt any FOUR [20]**
- a Differentiate between analog and digital communication system
 - b Define: a) Noise Figure b) Signal to Noise Ratio c) Image Frequency
 - c Why is VSB amplitude modulation used in television broadcasting?
 - d Modulation improves the quality of communication, justify this statement.
 - e How important is multiplexing in communication system?
- 2 a Explain with block diagram and waveforms of SSB AM generation. [10]**
- b Derive the wave equation for AM wave. Draw the time domain and frequency domain representation of AM wave. [10]**
- 3 a Explain the working of Foster Seeley discriminator as FM demodulator. What are its advantages over balanced slope detector? [10]**
- b State and prove sampling theorem. State the consequences of not satisfying Nyquist criteria in sampling [10]**
- 4 a What is the need of multiplexing? Explain the time division multiplexing in detail along with its applications. [10]**
- b Explain Delta Modulation in detail and what are its drawbacks? [10]**
- 5 a State and explain Friss formula and define Equivalent Noise Temperature. [10]**
- b Explain the working of diode detector. How is practical diode detector different from diode detector? [10]**
- 6 a Draw block diagram of Super heterodyne receiver and explain its characteristics. [10]**
- b What is narrowband and wideband FM? [5]**
- c Draw and explain the difference between PAM, PPM and PWM. [5]**

21/05/2025 SE EXTC SEM-IV C-SCHEME SS QP CODE: 10083524

Duration: 3hrs

[Max Marks:80]

N.B. : (1) Question No 1 is Compulsory.

(2) Attempt any three questions out of the remaining five.

- 1 Attempt any FOUR [20]
- a Find the fundamental period of the signal $x(t)=3\cos 4\pi t+2\sin 8\pi t$ [05]
- b Compare energy and power signal [05]
- c Find the initial value and final value of the Laplace transform $X(s) = \frac{7s+6}{s(3s+5)}$ [05]
- d Find the Z-transform of $x[n]=0.5^n u[n]$. [05]
- e Using duality property, find out the Fourier transform of $\delta(t)$ [05]
- 2 a Obtain the Fourier transform of a rectangular pulse with duration T and amplitude A in the interval $-\frac{T}{2} < t < \frac{T}{2}$ [10]
- b $x[n] = \{1, 1, 1, 1, 2\}$. Sketch $x[n-2]$, $x[-n]$, $x[-3-n]$, $x[2n]$, $x[\frac{n}{2}]$. [10]
Underline in $x[n]$ shows origin.
- 3 a Find the inverse Laplace transform of $X(s)=\frac{2}{s(s+2)(s+4)}$ for all possible ROCs. [10]
- b Test the given systems for Linearity, Causality, Stability, Memory and Time Invariant [10]
- i. $Y(t)=x(t^2)$
- ii. $Y(n)=x(-n)$
- 4 a Find $x[n]$ using partial fraction method from the given function $X(Z) = \frac{z-4}{(z-1)(z-2)^2}$ [10]
- b Find the convolution of given two signals $x_1(t) = e^{-2t}u(t)$ and $x_2(t) = e^{-5t}u(t)$. [10]
- 5 a Find the transfer function $H(z)$ and impulse response $h[n]$ of a discrete time system with I/O relation $y(n) - 3y(n-1) - 4y(n-2) = x[n] + 2x[n-1]$ [10]
- b Realize the given IIR system using Direct form I and Direct Form II. [10]
- $$H(z) = \frac{8z^3 - 4z^2 + 11z - 2}{(z - \frac{1}{4})(z^2 - z + \frac{1}{2})}$$
- 6 Explain any two [05]
- i. Properties of Laplace Transform [10]
- ii. Sampling theorem for lowpass Signals
- iii. FIR Filters and Linear phase Filters
