2021UG2050

भारतीय सूचना प्रौद्योगिकी संस्थान राँची

INDIAN INSTITUTE OF INFORMATION TECHNOLOGY, RANCHI

Jharkhand

Department of Electronics and Communication Engineering

B. Tech (Hons.) MID - SEMESTER EXAMINATION-Spring Semester 2022-23

Course Code: **EC 2002** Course Title: **Electromagnetic Theory**

Date: 27.02.2023 Day: **Monday**

Course Instructor: **Dr. Santosh Kumar Mahto**

Duration: 2 Hours Max. Marks: 60

Instructions:

1. **Question no. 1 to 3 are compulsory.**
2. The figure in the right-hand margin indicates full marks.
3. Missing data, if any, may suitably be assumed.
4. Symbols have their usual meaning.

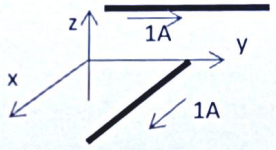
---

1 I. Consider the vector field $\boldsymbol{F} = (4y - Cz)\vec{a}_x + (4x + 2z)\vec{a}_y + (2y + z)\vec{a}_z$ in a rectangular coordinate system with unit vectors $\vec{a}_x$, $\vec{a}_y$ and $\vec{a}_z$ along x, y and z-axis respectively. If the field F is irrotational (conservative), then the constant C (in integer) is _____. [2]

II. Medium 1 has the electrical permittivity$\varepsilon_1 = 1.5\varepsilon_0 F/m$ and occupies the region to the left of z=0 plane. Medium 2 has the electrical permittivity $\varepsilon_2 = 2.5\varepsilon_0 F/m$ and occupies the region to the right of z=0 plane. If E1 in medium is $\vec{E}_1 = 5\vec{a}_x - 3\vec{a}_y + \vec{a}_z\, V/m$, then $\vec{E}_2$in the medium 2 is..... [2]

III. Two infinitely long wires carrying current are as shown in the figure below. One wire is in the y-z plane and parallel to y-axis. The other wire is in the x-y plane and parallel to x-axis. Whch component of the resulting magnetic field are non-zero at the origin? [2]

i. x, y, z components
ii. x, y components
iii. y, z components
iv. x, z components



IV. A materiaal is described by the following electrical parameters as a frequency of 10GHz, $\sigma = 10^6\, mho/m$, $\mu = \mu_0$and $\varepsilon/\varepsilon_0 = 10$. The material at this frequency is considered to be [2]

i. a good conductor
ii. a good dielectric
iii. neither a good conductor nor a good dielectric
iv. a good magnetic material

V. On the either of a charge-free interface between two media (chose the correct options) [2]

(a) the normal components of the electric field are equal
(b) the tangential component of the electric field are equal
(c) the normal components of the electric flux density are equal
(d) the tangential components of the electric flux density are equal

VI. If $E = -(2y^3 - 3yz^2)\vec{a}_x - (6xy^2 - 3xz^2)\vec{a}_y + 6xyz\vec{a}_z$ is the electric field in a source free region, a valid expression for the electrostatic potential is [2]

a. $xy^3 - yz^2$
b. $2xy^3 - xyz^2$
c. $y^3 + xyz^2$
d. $2xy^3 - 3xyz^2$

VII. Units of $\nabla \times H$ and Electric Flux Density (D) are _____ and _____ respectively. [2]

VIII. For static electric and magnetic fields in an homogenous source-free medium, which of the following represents the correct form of Maxwell's equations? [2]

i. $\nabla . E = 0,\ \nabla \times B = 0$
ii. $\nabla . E = 0,\ \nabla . B = 0$
iii. $\nabla \times E = 0,\ \nabla \times B = 0$
iv. $\nabla \times E = 0,\ \nabla . B = 0$

IX. A vector P is given by $P = x^3y\hat{x} - x^2y^2\hat{y} - x^2yz\hat{z}$. Which one of the following statements is TRUE. [2]

i. P is solenoidal, but not irrotational.
ii. P is irrotational, but not solenoidal.
iii. P is neither solenoidal nor irrotational.
iv. P is both solenoidal norirrotational.

X. Faraday's law of electromagnetic induction is mathematically described by which one of the following equations? [2]

i. $\nabla . B = 0$
ii. $\nabla . D = \rho_v$
iii. $\nabla \times E = -\frac{dB}{dt}$
iv. none of these

2. a. Derive the Maxwell third and fourth equation by the basic equations? [10]
   b. Derive the expression of continuity equation. [5]
   c. Derive the boundary conditions in magnetic field. [5]

3. a. Write the physical significance of Gradient, Divergence and Curl of fields. [5]
   b. Consider the two-dimensional vector field $F = x\vec{a}_x + y\vec{a}_y$, where $\vec{a}_x$ and $\vec{a}_y$ denote the unit vectors along the x-axis and the y-axis, respectively. A contour C in the x-y plane, as shown in the figure, is composed of two horizontal lines connected at the two ends by two semi-circular arcs of unit radius. The contour is traversed in the counter-clockwise sense. Evaluate the closed path integral $\oint F(x, y).(dx\vec{a}_x + dy\vec{a}_y)$ and verify the result using Stoke's theorem. [5]

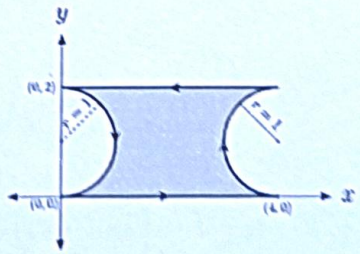


Figure 1

   c. A given point P(-2,6,3) and vector $A = ya_x + (x + y)a_y$, express P and A in cylindrical and spherical coordinate system. EvaluateA at P in the cartesian, cylindrical and spherical coordinate systems. [10]

All is well

2021UG2050

Indian Institute of Information Technology Ranchi

Department of CSE and ECE

B. Tech Mid Semester Examination – Autumn Semester 2022-23

Semester: 4th **Branch: CSE and ECE**

Course Code: EC 2004 **Course Name: Microprocessors and Microcontrollers**

QUESTION PAPER

Duration: 2 hrs. **Max Marks: 60**

Instructions:

(1) Answer all the questions. Number in [ ] indicates marks.
(2) Scientific calculator is allowed in the examination.
(3) Any missing data can be assumed suitably.

1 **(a)** Discuss the different addressing modes in 8085 microprocessor with one example. **[5]**

(b) The accumulator value after the execution of fifth instruction on 8085 microprocessor **[5]**

```
MVI A, 33H
MVI B, 78H
ADD B
CMA
ANI 32H
```

(c) Discuss in detail about different jump instructions. **[5]**

2 **(a)** Find the number of bytes of the following instructions: **[5]**

```
MVI C,55H
SUB D
```

(b) An 8085 assembly language program is given below. After the execution of the program the content of the accumulator is **[10]**

```
MVI A, 07H
RLC
MOV B, A
RLC
RLC
ADD B
```

3. Draw the PIN diagram of 8085 microprocessor and explain the functioning of all the pins [10]

4. Write an assembly language program to subtract two 16-bit numbers in 8085. [10]

5. Give the register organization of 8085 in detail. [10]

End

2021UG2057

Indian Institute of Information Technology Ranchi

Department of Electronics and Communication Engineering

B. Tech Mid Semester Examination – Autumn Semester 2022-23

Semester: IV **Branch:** ECE/CSE/ECE(ES&IoT)

Course Code: EC-2006/EI-2006 **Course Name:** Signal and Systems

QUESTION PAPER

Duration: 2 hrs. **Max Marks: 60**

Instructions:

(1) Answer all the questions. Number in [ ] indicates marks.
(2) Scientific calculator is allowed in the examination.
(3) Any missing data can be assumed suitably.
(4) All symbol has their usual meaning.

1 **(a)** Express the signal $x(t)$ shown in figure 1 in terms of unit step functions. **[3]**

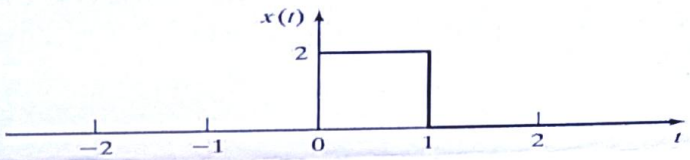


Figure 1: Signal $x(t)$.

(b) Calculate its derivative and sketch it. **[3+3]**

2 A contineous-time signal is shown in figure 2. Sketch each of the following signal.

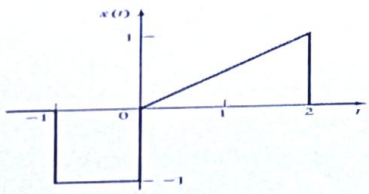


Figure 2: Signal $x(t)$.

(a) $y(t) = x(-2t + 3)$ **[5]**

(b) $y(t) = 3x(t) - 1$ **[5]**

3 **(a)** Check whether the following system is stable, causal, and time-invariant. **[3]**

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

(b) Find the even and odd components of **[3]**

$$x(t) = 2\cos(t) - \sin(t) + 3\sin(t)\cos(t)$$

[P.T.O]

4. **(a)** Determine whether the following signals are energy signal, power signal, or neither. [3]

$$x(t) = \begin{cases} e^{-2t}, & t \geq 0 \\ 0, & otherwise \end{cases}$$

(b) Express the signals shown in figure 3 in terms of unit step functions [3]

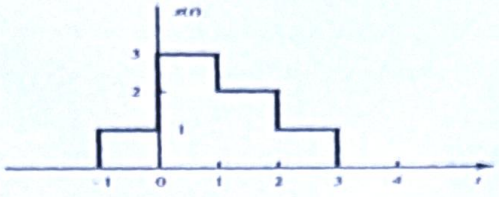


Figure 3: Signal $x(t)$.

5. **(a)** Sketch the following signal: [3]

$$y(t) = r(t) - 2r(t-2) + r(t-4)$$

(b) Evaluate the following integral: [3]

$$f(t)=\int_{-\infty}^{\infty}(t^3 - 3t + 1)\delta(t-2)dt$$

(c) Consider $x[n]$ and $h[n]$ as shown in figure 4(a) and (b), respectively. (The signals are all zero outside the ranges indicated.) Find $y[n] = x[n] * h[n]$. [8]

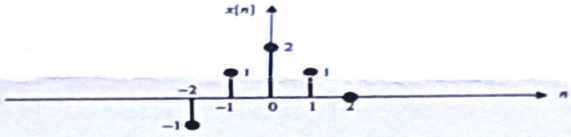


Figure 4(a): The input signal$x[n]$.

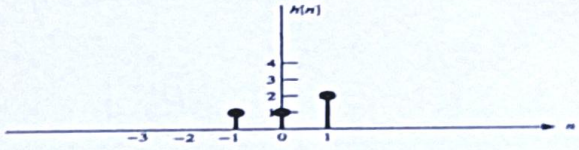


Figure 4(b): The impulse response h[n].

6. Write down the difference between the following

(a) Continuous-time and Discrete-time Signals [3]

(b) Energy and Power Signals [3]

(c) Caual and Non-Causal Systems [3]

(d) Linear and Nonlinear Systems [3]

(e) Time-varying and Time-invarient Systems [3]

End

2021UG2050

Indian Institute of Information Technology Ranchi

Department of ECE

B. Tech (Hons.) Mid Semester Examination – Spring Semester 2022-23

Semester: 4th **Branch: ECE**

Course Code: EC-2008 **Course Name: Analog Communication**

QUESTION PAPER

Duration: 2 hrs. **Max Marks: 60**

Instructions:

(1) Attempt all questions. Number in [ ] indicates marks.

(2) Assume the suitable data, if required.

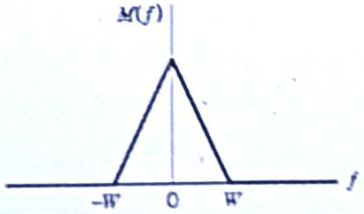
1. Find Fourier transform of the signals shown in Figure. [7]

2. Consider a message signal $m(t)$ with the spectrum shown in Figure. The message bandwidth W= 1 kHz. This signal is applied to a product modulator, together with a carrier wave $A_c\cos(2\pi f_c t)$, producing the DSB-SC modulated signal $S(t)$. The modulated signal is next applied to a coherent detector. Assuming perfect synchronism between the carrier waves in the modulator and detector, determine the spectrum of the detector output when: [7]

   (a) The carrier frequency $f_c = 1.25\ kHz$ and

   (b) The carrier frequency $f_c = 0.75\ kHz$.

What is the lowest carrier frequency for which each component of the modulated signal $S(t)$ is uniquely determined by $m(t)$.

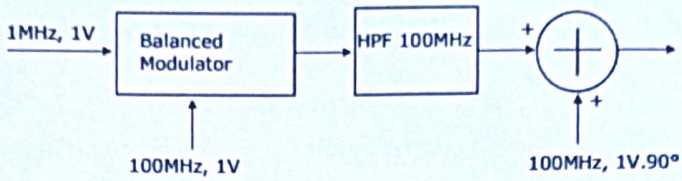


3. Describe Hilbert transform with suitable examples. Derive the equation for SSB-SC modulated signal using phase discriminator method. [7]

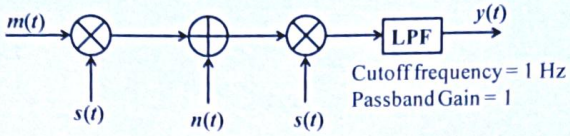
4. Discuss the modulation techniques for DSB-SC using suitable diagrams. [7]

5. A 100 MHz carrier of 1 V amplitude and a 1 MHz modulating signal of 1 V amplitude are fed to a balanced modulator. The output of the modulator is passed through an ideal high pass filter with cut-off frequency of 100 MHz. The output of the filter is added with [7]

100 MHz signal of 1 V amplitude and 90° phase shift as shown in figure. Calculate the envelope of the resulting signal.



6. In the figure $m(t) = \frac{2sin2\pi t}{t}$, $s(t) = cos200\pi t$ and $n(t) = \frac{sin199\pi t}{t}$. Calculate the output y(t). [7]



7. Derive an equation for total transmitted power in an AM system. Also discuss the variations of carrier power and total side band power with percentage modulation using suitable diagram. [7]

8. Discuss the advantages and drawbacks of AM and DSB-SC using suitable diagrams. Describe the Costas receiver for demodulating DSB-SC waves. [7]

9. (i). The Hilbert transform of $cos\omega_1 t + sin\omega_2 t$ is [1]

(a) $sin\omega_1 t - cos\omega_2 t$ (b) $sin\omega_1 t + cos\omega_2 t$

(c) $cos\omega_1 t - sin\omega_2 t$ (d) $sin\omega_1 t + sin\omega_2 t$

(ii) A 1 MHz sinusoidal carrier is amplitude modulated by a symmetrical wave of period 100 μsec. Which of the following frequencies will NOT be present in the modulated signal? [1]

(a) 990 kHz (b) 1010 kHz (c) 1020 kHz (d) 1030 kHz

(iii) In a double side-band (DSB) full carrier AM transmission system, if the modulation index is doubled, then the ratio of total sideband power to the carrier power increases by a factor of _____. [1]

(iv) Considering sinusoidal modulation in an AM system. Assuming no overmodulation, the modulation index μ when the maximum and minimum values of the envelope, respectively, are 4 V and 1 V is_____. [1]

Roll No. 2021UG12050

Indian Institute of Information Technology Ranchi

Department of Electronics and Communication Engineering

B. Tech Mid Semester Examination – Spring Semester 2022-23

Semester: 4th **Branch: ECE & ECE (ES&IoT)**

Course Code: EC 2010/EI-2010 **Course Name: Control System**

QUESTION PAPER

Duration: 2 Hrs. **Max Marks: 60**

Instructions:
(1) Answer all the questions. Number in [ ] indicates marks.
(2) Scientific calculator is allowed in the examination.
(3) Any missing data can be assumed suitably.
(4) All symbols have their usual meaning.

1 (a) Differentiate open loop and closed loop control system? [5]

(b) Derive an expression for the transfer function of field control DC servomotor. [7]

(c) Draw a free body diagram and write differential equation describing the dynamics of the system shown in Fig. 1. Also, calculate the overall transfer function $X_1(s)/F(s)$. [8]

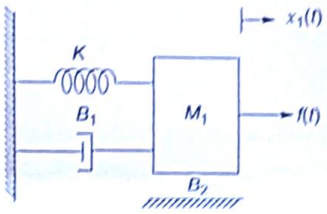
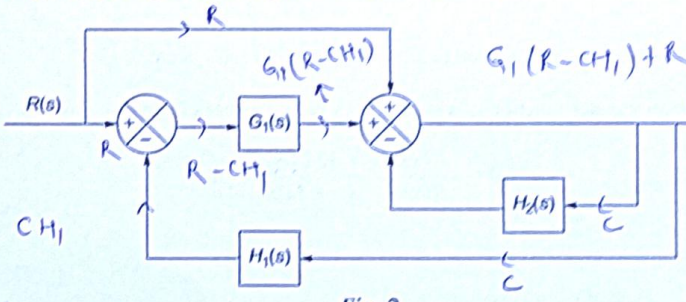


Fig. 1

2 (a) Reduce the block diagram shown in Fig. 2 to a single block and determine the transfer function C(s)/R(s) using block diagram reduction technique. [10]



$G_1(R-CH_1)+R-CH_2 = C$

$G_1R - CH_1G_1 + R - CH_2 = C$

$R(1+G_1) = C(1+H_2+G_1H_1)$

$\frac{C}{R} = \frac{1+G_1}{1+H_2+G_1H_1}$

Fig. 2

(b) Calculate the overall transfer function $\frac{x_5}{x_1}$ of the given control system shown in Fig. 3 with the help of Mason's gain formula: [5]

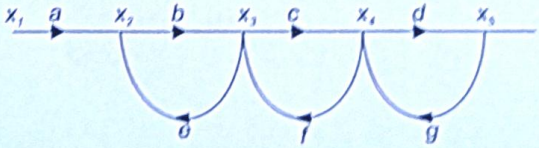


Fig. 3

(c) Find the transfer function $\frac{C(s)}{R(s)}$ for the system shown in Fig. 4 using the signal flow graph method. **[5]**

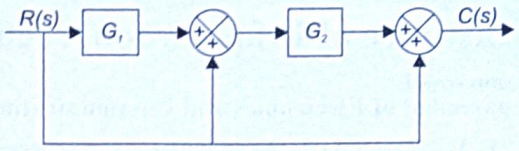


Fig. 4

3 **(a)** In a RLC series circuit shown in Fig. 5, the value of resistance, inductance and capacitance are 1kΩ, 10 mH, 10 nF respectively. **[10]**

Determine the transfer function $\frac{V_0}{V_{in}}$ and time response characteristics mentioned below:

i) Damping frequency
ii) Rise time
iii) Peak time
iv) Maximum overshoot (%)
v) Settling time for 5% error.

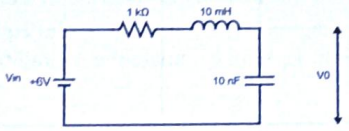


Fig. 5

(b) The closed-loop transfer functions of certain second-order unity feedback control systems are given below. **[2.5x2]**

i) $\frac{C(s)}{R(s)} = \frac{8}{s^2 + 3s + 8}$

ii) $\frac{C(s)}{R(s)} = \frac{1}{s^2 + 2s + 1}$

Determine the type of damping and natural frequency of each system.

(c) The open-loop transfer function of a system with unity feedback is given below: **[5]**

$$G_1(S) = \frac{C(s)}{R(s)} = \frac{40\,(s+2)}{s(s+1)(s+4)}$$

Determine:

i) Type of control system
iii) Position error constant
iv) Velocity error constant
v) Acceleration error constant
vi) steady-state error for unity ramp input

End

Roll No. 2021UG2050

Indian Institute of Information Technology Ranchi

Department of ECE/CSE

B. Tech Mid Semester Examination – Spring Semester 2022-23

Semester: IV	**Branch: ECE/CSE/ECE(ES&IoT)/CSE(DS&AI)**
Course Code: ES 2002	**Course Title: Environmental Science and Green Technology**

QUESTION PAPER

Duration: 2 hrs.	**Max Marks: 60**

Instructions:
(1) Answer all questions. Number in [ ] indicates marks.
(2) Any missing data can be assumed suitably.

1	(a)	Discuss the significance of environmental education	[5]
	(b)	Describe how the human life is dependent on environment	[5]
	(c)	Outline the key indicators of water quality	[5]
	(d)	Discuss the various steps of water quality monitoring process	[5]
2	(a)	Compare between slow sand filter and rapid sand filter	[6]
	(b)	List the major types of water pollutants and describe any **ONE** in detail	[4]
	(c)	Write short notes on any **FOUR** (i) Ecosystem (ii) Global warming (iii) Ozone depletion (iv) Acid rain (v) Greenhouse gases (vi) Carbon cycle	[10]
3	(a)	Discuss the various disinfection/sterilization methods of water treatment	[10]
	(b)	Define air pollution. Describe the various types of air pollutants, their sources and detrimental effects on human life and environment. Propose a few methods by which air pollution can be minimized.	[10]

End