III EXTC CBGS

AE I

23/11/17

Q. P. Code: 24888

Duration: 3hours **Maximum Marks: 80**

N.B.: (1) Question **No. 1 is compulsory**.

(2) Solve any **three** questions from the **remaining five.**

(3) Figures to the right indicate full marks.

(4) Assume suitable data if necessary and mention the same in answer sheet.

Q.1 Attempt any 5 questions [20]

a) Write down current equation of diode and explain significance of each parameter.

b) Calculate I_B, I_C and V_{CE} for the common emitter circuit shown in Fig. 1b

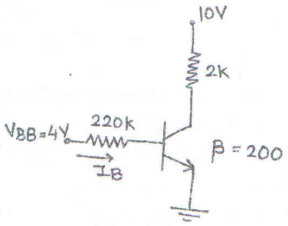

Fig. 1b

c) Explain effect of temperature on JFET and derive equation for zero temperature drift.

d) Compare CE, CB and CC configuration.

e) Draw small signal hybrid pi model of BJT including early effect.

f) Why LC oscillators are preferred for high frequency applications?

Q.2 a) Draw the output waveform for the clipper and clamper circuit shown in Fig 2a and 2b. [10]

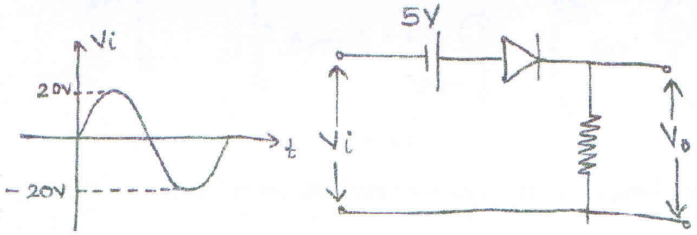

Fig. 2a

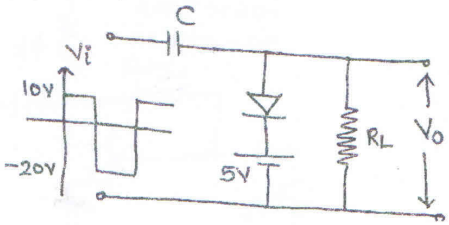

Fig. 2b

b) Derive the expression for frequency of oscillation for a transistorized (BJT) RC phase shift oscillator. [10]

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Q.3 a) Find I_{CQ} and V_{CEQ} for the circuit shown in Fig 3a if $\beta = 100$. [10]

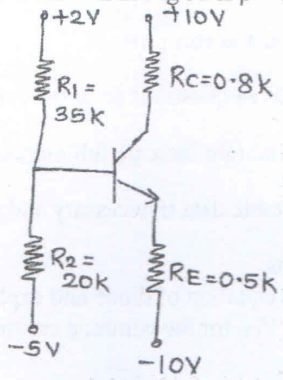

Fig. 3a

b) Explain the construction and characteristics of N-channel Enhancement MOSFET. Draw transfer and drain characteristics. [10]

Q.4 a) For the circuit shown in Fig, 4a, determine V_{GSQ} and V_{DSQ}. Also calculate voltage gain, input impedance and output impedance. [10]
$V_{TN} = 1V$, $K_N = 0.5\ mA/V^2$, $\lambda = 0.01V^{-1}$.

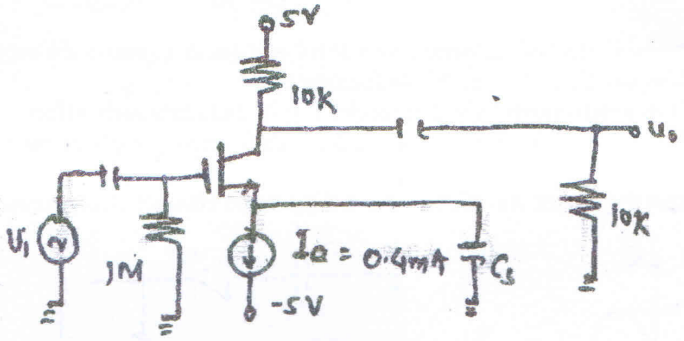

Fig.4a

b) Find I_{DQ}, V_{GSQ}, V_{DSQ} , V_D and V_S for the circuit shown in Fig 4b. [10]

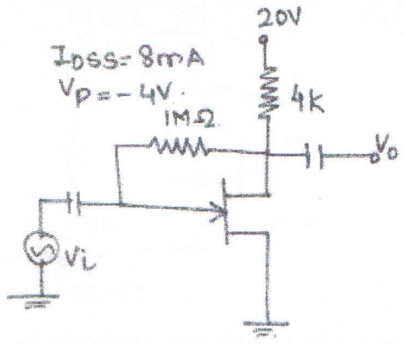

Fig. 4b

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Q.5 a) For the circuit shown below in Fig.5b, the transistor parameters are $V_{BE\,(on)} = 0.7$ V, $\beta = 100$ and $V_A = \infty$. Determine Z_i, Z_o and A_V [10]

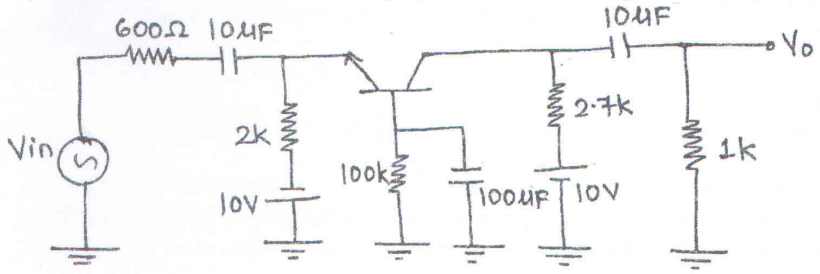

Fig. 5a

b) Draw and explain energy band diagram of MOS capacitor in accumulation, depletion and inversion region. [10]

Q.6 Short notes on: (Attempt any four) [20]

a) Construction and operation of varactor diode
b) Crystal oscillator
c) Transistor as a switch
d) Emitter follower.
e) Regions of operation of FET

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(REVISED COURSE)

(3 Hours) **[Total Marks: 80]**

Note: 1) Q.1 is compulsory

2) Answer any 3 out of remaining questions

Q.1 (A) Explain the function of SID, TRAP , ALE, and AD0-AD7 pins of processor 8085. (5)

(B) Write features of 8087 math co-processor. (5)

(C) Explain advantages of memory segmentation (5)

(D) Write control word of 8255 to initialize port A as input port, port B and C as output port, group A in mode 0 and group B in mode 1 (5)

Q.2 a) What are different types of interrupt supported by 8086 and explain IVT. (10)

b) Draw and explain the architecture of 80286 processor. (10)

Q.3 a) Draw and explain the interfacing of Math co-processor with 8086. (10)

b) Explain Minimum mode of 8086 microprocessor. Draw timing diagram for write operation in Minimum mode. (10)

Q.4 a) Design an 8086 based system with following specifications. (10)

i. 8086 CPU working at 8MHz
ii. 16 KB EPROM using 8K device
iii. 32 KB SRAM using 16K device

b) Describe the importance of 8257 DMA controller. Explain method of interfacing DMA controller with 8086 microprocessor. (10)

Q.5 a) Write a programme to set up 8253 as square wave generator with 1 ms period if input frequency of 8253 is 1 Mz (10)

b) Explain Bit Set Reset mode of 8255 with application. (10)

Q.6 a) Write a program for 8086 to find out the maximum number from the array of 10 numbers. (10)

b) Draw and explain interfacing of ADC 0808 with 8086 Microprocessor using 8255. (10)

(3 Hours) **[Total Marks: 80]**

N.B.:

1. Question No.1 is compulsory.
2. Attempt any three questions out of the remaining five.
3. Assume suitable data wherever necessary.

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1. Answer the following 20

a) Determine whether the following signals are energy signals or power signals and calculate their energy or power.
(1) $x(t) = e^{-4t}u(t)$
(2) $x(n) = (\frac{1}{6})^n u(n)$

b) Determine if following system is memoryless, causal, linear, time invariant.
$y(t)=a^n x(n)$

c) Using properties of Fourier transform, determine Fourier transform of x(t)
$x(t) = e^{-3|t-t0|} + e^{3|t+t0|}$

d) Find out even and odd components of following signals:
(i)$x(n) = u(n) – u(n-5)$
(ii)$x(t) = 5+7t+9t^2$

e) Determine relation between continuous time Fourier Transform and Laplace Transform.

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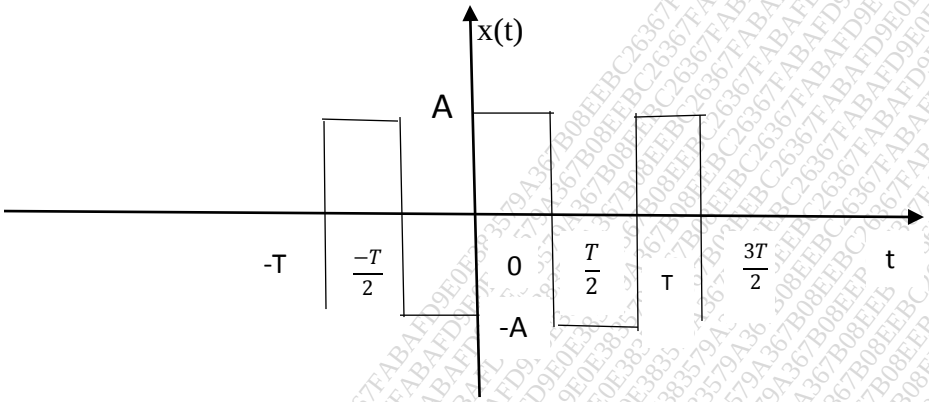
2. (a) Determine Fourier Series representation of following signal: 10



(b) Find impulse response and step response of continuous time systems governed by 10 Following transfer functions.

$$H(s) = \frac{s+3}{s^2+6s+8}$$

3. (a) A continuous time signal is defined as, 10

x(t) = t;$0 \leq t \leq 3$

x(t) = 0;t> 3

Sketch waveforms of following signals:

(i) x(-t) (ii) x(2-t) (iii) x(3t) (iv) x(0.5t+1)

(b) Determine inverse z-transform of following function using long division method: 05

$$X[z] = \frac{z^2+2z}{z^3-3z^2+4z+1}; ROC; |z| > 1$$

(c) Compute the DTFT of sequence x (n) = {0, 1, 2, 3}.Sketch magnitude and phase 05 Spectrum.

Q4] (a) Using Laplace Transform determine complete response of system described by following Equation. 10

$\frac{d^2y(t)}{dt^2} + 6\frac{dy(t)}{dt} + 8y(t) = \frac{dx(t)}{dt} + x(t)$; where $y(0) = 1; \frac{dy(0)}{dt} = 3$, for input $x(t) = u(t)$

(b) Find impulse response of system described by following difference equation 10

$y(n) - \frac{3}{4}y(n-1) + \frac{1}{8}y(n-2) = x(n) + x(n-1)$ where all initial conditions are zero.

5. (a) For the following continuous time signals, determine Fourier Transform. 10

(i) $x(t) = e^{-at} u(-t)$

(ii) $x(t) = \sin\omega_0(t)u(t)$

(b) Determine Fourier series representation of $x(n) = 4\cos\frac{\pi n}{2}$ 05

(c) Determine cross correlation of sequence $x(n) = \{1,1,2,2\}$ and $y(n) = \{1,3,1\}$ 05

6. (a) The input signal x(t) and impulse response h(t) of a continuous-time system are described as follows 10

$x(t) = e^{-3t} u(t)$ and $h(t) = u(t-1)$. Find output of system using convolution integral.

(b) Determine Z Transform and ROC of 10

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

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

(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) If λ is eigen value of A and X is corresponding eigen vector of λ then show that λ^n is eigen value of A^n and corresponding eigen vector is X $(n>0)$. (5)

(b) Evaluate $\int_C \frac{z^2-2z+4}{z^2-1}\,dz$, where C is $|z-1|=1$. (5)

(c) Find the extremals of $\int_{x_1}^{x_2}(1+x^2y')y'\,dx$. (5)

(d) Find a unit vector orthogonal to both $u=(-3,2,1)$ and $v=(3,1,5)$. (5)

Q.2

(a) Find eigen values and eigen vectors of A^2+2I where $A=\begin{bmatrix}8 & -8 & -2\\ 4 & -3 & -2\\ 3 & -4 & 1\end{bmatrix}$. (6)

(b) Find the extremals of $\int_{x_1}^{x_2}\left[(y'')^2-y^2\right]dx$. (6)

(c) Obtain Laurent's series expansion of $f(z)=\frac{4z+3}{z^2-z-6}$ at $z=1$. (8)

Q.3 (a) Using Rayleigh-Ritz method find solution for the extremal of the functional $\int_0^1\left[(y')^2-2y-2xy\right]dx$ with $y(0)=2$ and $y(1)=1$. (6)

(b) Evaluate $\int_0^\infty \frac{1}{(x^2+1)(x^2+9)}\,dx$. (6)

(c) Show that matrix $A=\begin{bmatrix}-9 & 4 & 4\\ -8 & 3 & 4\\ -16 & 8 & 7\end{bmatrix}$ diagonalizable. Also find diagonal and transforming matrix. (8)

[Turnover]

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Q.4

a) Verify Cayley Hamilton Theorem for $A=\begin{bmatrix}1 & 2 & -2\\ -1 & 3 & 0\\ 0 & -2 & 1\end{bmatrix}$. Also find A^{-1}. (6)

(b) Using Cauchy's Residue Theorem evaluate $\int_0^{2\pi}\frac{d\theta}{3+2\cos\theta}$. (6)

(c) Show that the extremal of isoperimetric problem $I=\int_{x_1}^{x_2}(y')^2\,dx$ subject to the condition $\int_{x_1}^{x_2} y\,dx=k$ is a parabola. (8)

Q.5 (a) Find 5^A where $A=\begin{bmatrix}3 & 1\\ 1 & 3\end{bmatrix}$. (6)

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

(c) Reduce the following quadratic form into canonical form and hence find its rank, index, signature and value class (8)
$Q=5x_1^2+26x_2^2+10x_3^2+6x_1x_2+4x_2x_3+14x_3x_1$.

Q.6 (a) State and prove Cauchy-Schwartz inequality. Hence show that for real values of a,b,θ $(a\cos\theta+b\sin\theta)^2\le a^2+b^2$. (6)

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

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

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Time: 3 Hours **Marks: 80**

NOTE :

1. Question No.**1**. is **compulsory**. Attempt any **four** out of **five** in it.
2. Attempt any **three** out of remaining **five**.
3. Assume suitable data, wherever **necessary** and **justify** the same.
4. Figures to the right indicate marks.

1. A) A point charge Q_1 = 300 µC is located at P_1(1, -1, -3) m experiences a force $\overrightarrow{F_{21}} = 8\,\hat{a}_x - 8\,\hat{a}_y + 4\,\hat{a}_z$ (N) due to a point charge Q_2 at P_2(3, -3, -2) m. Determine Q_2. **(5)**

B) What is Ionosphere? Which layers are present during day and night time? Where does maximum attenuation of an electromagnetic wave take place inside the ionosphere? Hence define critical frequency. **(1+1+1+2)**

C) Explain Super refraction and Sub-refraction. **(5)**

D) State the Maxwell's equations for free space in integral and point form. Also state their significance. Which one of these equations tells us the propagation of electromagnetic wave in air? **(2+2+1)**

E) Compare MOM, FEM and FDM. **(5)**

2. A) Derive boundary conditions for both Electric and Magnetic fields for conductor-dielectric interface. **(10)**

B) State Poynting theorem. Derive its final expression and explain the meaning of each term. **(2+5+3)**

3. A) If the electric flux density $\vec{D} = 4xy\,\hat{a}_x + 2(x^2 + z^2)\,\hat{a}_y + 4yz\,\hat{a}_z$ (C/m^2), using Gauss's Law find the following **(10)**

i) The volume charge density at (-1, 0, 3).
ii) The flux through the cube defined by
$0 \le x \le 2,\ 0 \le y \le 3,\ 0 \le z \le 5.$
iii) The total charge enclosed by the cube.

B) For the one dimensional differential equation $\frac{\partial^2 V}{\partial x^2} = 0$, $0 \le x \le 4$. Obtain V(1) using FDM. Given V(0)=0 and V(4)=20. Perform band matrix method. **(5)**

C) State some applications of electromagnetism. With the help of neat schematic, explain the working of electromagnetic pump. **(1+4)**

4. A) Obtain the reflection and transmission coefficient in case of reflection from perfect dielectric at normal incidence. **(10)**

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B) Derive an expression for the electric field intensity $\vec{E}$ due to a conductor of infinite length and having charge density ρ_l . **(10)**

5. A) Obtain an expression for MUF in terms of d, H and f_c. **(5+5)**
If a high frequency communication link is to be established between two points on the Earth 2000 km away, and the reflection region of ionosphere is at height of 200 km and has critical frequency of 5 MHz, then calculate the MUF for the given path.

B) Find the maximum distance that can be conveyed by a space wave when the transmitting and receiving antenna heights are 60 m and 6 m respectively. Assume standard atmosphere. **(5)**

C) With regards to the ionosphere discuss the following : **(5)**
i) E layer
ii) Sporadic E layer

6. A) Derive wave equations in lossy media. **(10)**

B) A media has the following properties $\varepsilon_r = 1$; $\mu_r = 1$; $\sigma = 10^{-4}$ (mho/m) at 1 GHz. Determine : **(5)**
i) Propagation constant
ii) Attenuation constant in dB
iii) Wavelength
iv) Refractive index
v) Loss tangent
Is the media behaving like a conductor or dielectric?

C) Explain formation of duct and condition for duct propagation. **(5)**

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