**Q. P. Code: 27087**

**[Time: Three Hours]** **[Marks:80]**

**N.B.: (1) Question No.1 is compulsory.**
**(2) Attempt any three out of remaining questions.**
**(3) Assume suitable data wherever required.**

Q.1. Attempt the following (20)

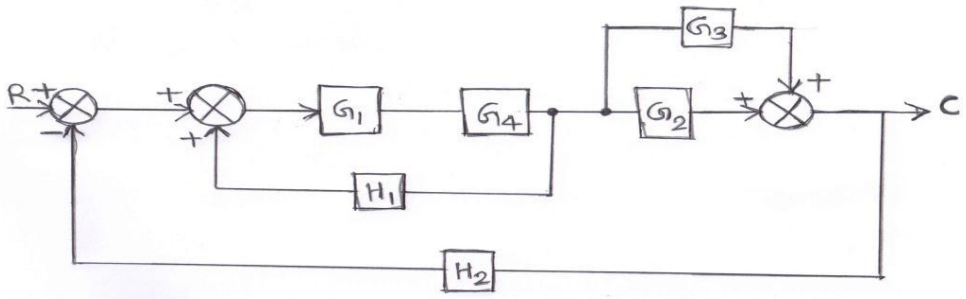
a) Differentiate between Open Loop and Closed Loop Control System.

b) Define the terms (i) Zero input response (ii) Zero state response.

c) Define Absolute, Relative and Robust Stability of the System.

d) What are the drawbacks of transfer function model?

Q.2 a. Find the transfer function C(S)/R(S) of the system Shown in the figure below. (10)




b. Sketch the root locus for the below given System. (10)

$$G(S)H(S) = \frac{K}{s(s+3)(s+5)}$$

Q. 3 a. Obtain the State Variable model of the transfer function given below. (10)

$$T(S) = \frac{s^2+3s+3}{s^3+2s^2+3s+1)}$$

b. Explain Controllability and Observability analysis of LTI System using Suitable example. (10)

Q.4 a. Use the Routh Stability Criteria to determine the range of 'K' for stability of unity feedback system whose Open Loop transfer function is given below. (10)

$$G(s) = \frac{K}{s(s+1)(s+2)}$$

**[TURN OVER]**



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b. If (10)

$$G(s)H(s) = \frac{K(s+1)}{s^2(s+2)(s+4)}$$

Using Polar Plot determine the range of 'K' for stability. Verify result by Rouths Criteria.

Q.5 a. Draw the Bode diagram for the transfer function (10)

$$G(s) = \frac{64(s+2)}{s(s+0.5)(s^2+3.2s+64)}$$

Determine $G_m$, $P_m$, $W_{gc}$ and $W_{pc}$. Comment on the Stability.

b. For the given transfer function find Tp, % MP, Ts, and Tr. (10)

$$G(s) = \frac{100}{(s^2+15s+100)}$$

Q.6 a. Explain the concept of Neuro-Fuzzy adaptive control system. Explain one method of adaptive control. (10)

b. Derive the expression for solution of homogeneous equation. (10)

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**Q.P. CODE: 36048**

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

**B)** Given the potential $V = 2x^2y - 5z$ (V) and a point P (-4, 3, 6), find **(2+2+1)**
   a) Electric field intensity at P
   b) Electric flux density at P
   c) Volume charge density at P

**C)** State the Maxwell's equations for good dielectric in integral and point form. Also state their significance. **(5)**

**D)** With the help of neat schematic diagram, explain the working of an Electromagnetic Pump. **(5)**

**E)** Explain Super refraction. **(5)**

**2. A)** Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. **(5+5)**
For $z > 0$, $\varepsilon_{r1} = 4$ and for $z < 0$, $\varepsilon_{r2} = 3$.
A uniform electric field $\vec{E}_1 = 5\hat{a}_x - 2\hat{a}_y + 3\hat{a}_z$ (kV/m) exists for $z \geq 0$. Find,
   a) $\vec{E}_2$ for $z \leq 0$.
   b) The angles $E_1$ and $E_2$ make with the interface.

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

**3. A)** What is ionosphere? Describe its various layers. Which layers are present during day and night time? Where maximum attenuation of electromagnetic waves takes place inside the ionosphere? **(10)**

**B)** State and derive FRISS transmission equation. **(10)**

**4. A)** Determine the potential at the free nodes in the potential system of Fig.1. using Finite Difference Method (Band Matrix Method). **(10)**

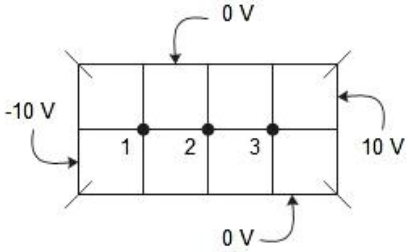


Fig.1.

**B)** Derive Helmholtz equations for Magnetic field in free space. **(5)**

**C)** For the normal incidence, determine the amplitudes of reflected and transmitted $\vec{E}$ and $\vec{H}$ at interface of two regions at $z = 0$. **(5)**
Given: Incident $E_i = 1.5 \times 10^{-3}$ (V/m); $\varepsilon_{r1} = 8.5$ ; $\mu_{r1} = 1$ ; $\sigma_1 = 0$ .
Second region is free space.



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**5. A)** Explain formation of duct and condition for duct propagation. **(10)**

**B)** 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.

**6. A)** Explain the formation of inversion layer in troposphere. **(5)**

**B)** Define critical frequency as a measure of ionospheric propagation and determine critical frequency for reflection at vertical incidence if the maximum value of electron density is $1.24 \times 10^6$ per CC. **(2+3)**

**C)** Consider a two element mesh as shown in Fig.2. Using FEM determine the potentials at free nodes. **(10)**

| Node | (x, y) |
|---|---|
| 1 | (0.8, 1.8) |
| 2 | (1.4, 1.4) |
| 3 | (2.1, 2.1) |
| 4 | (1.2, 2.7) |

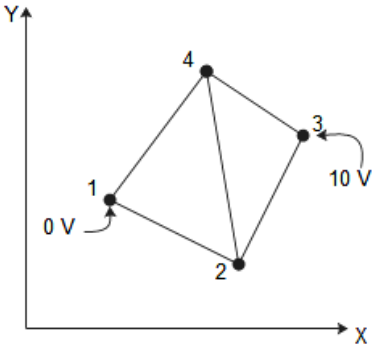


Fig.2.



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**Q. P. Code: 24492**

**Duration: 3 Hours** **Total Marks: 80**

N.B. : 1) Q.1. is compulsory.

2) Attempt any three from the remaining.

Q.1. a) Show that the set $\{e^x, xe^x, x^2e^x\}$ is linearly independent in $C^2(-\infty, \infty)$. (5)

b) Show that $\int_C \log z dz = 2\pi i$, where C is the unit circle in the z-plane. (5)

c) Find the projection of u=(3,1,3) along and perpendicular to v=(4,-2,2) (5)

d) Find the extremal of $\int_{x_1}^{x_2} \left(y^2 + y'^2 + 2ye^x\right) dx$ (5)

Q.2. a) If $A = \begin{bmatrix} 3/2 & 1/2 \\ 1/2 & 3/2 \end{bmatrix}$, find $e^A$ (6)

b) Evaluate $\int_0^{\pi} \frac{d\theta}{3 + 2\cos\theta}$ (6)

c) Find the singular value decomposition of $\begin{bmatrix} 1 & 2 \\ 1 & 2 \end{bmatrix}$ (8)

Q.3. a) Find the extremal of $\int_0^{\pi} \left(y'^2 - y^2\right) dx$ given $y(0) = 0, y(\pi) = 0$ (6)

b) Verify Cayley Hamilton theorem for $A = \begin{bmatrix} 1 & 2 & 3 \\ 2 & -1 & 4 \\ 3 & 1 & -1 \end{bmatrix}$ and hence find $A^{-1}$ & $A^4$ (6)

c) Expand $f(x) = \frac{1}{(z-1)(z-2)}$ in the regions (i) $1 < |z-1| < 2$ (ii) $|z| < 1$ (8)

Q.4. a) Construct an orthonormal basis of $R^3$ using Gram Schmidt process to
S = {(3,1),(2,3)} (6)

b) Find the extremum of $\int_{x_0}^{x_1} (2xy + y''^2) dx$. (6)

c) Reduce the quadratic form $6x^2 + 3y^2 + 3z^2 - 4xy + 4xz - 2zy$ to canonical form and hence, find its rank, index and signature and value class. (8)



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Q.5. a) Using Residue theorem evaluate $\int_C \frac{z^2}{(z-1)^2(z+1)}dz$ where C is |z|=2. (6)

b) Find the linear transformation Y=AX which carries $X_1 = (1,0,1)', X_2 = (1,-1,1)', X_3 = (1,2,-1)'$ onto $Y_1 = (2,3,-1)', Y_2 = (3,0,-2)', Y_3 = (-2,7,1)'$ (6)

c) Check whether $V = \mathbb{R}^2$ is a vector space with respect to the operations

$(x_1,0)+(x_2,0) = (x_1+x_2,0); k(x_1,0) = (kx_1,0)$ (8)

Q.6.a) Obtain Taylor's series expansion for $f(x) = \frac{2z^3+1}{z(z+1)}$ about $z = i$ (6)

b) Let $W = span\left\{(0,1,0), \left(\frac{-4}{5},0,\frac{3}{5}\right)\right\}$, Express $w$ =(1,2,3) in the form of $w = w_1 + w_2$ where

$w_1 \in W$ & $w_2 \in W^{\perp}$ (6)

c) Using Rayleigh- Ritz method, solve the boundary value problem $I = \int_0^1 \left(2xy - y^2 - y'^2\right)dx$ ;

given $y(0) = y(1) = 0$ (8)

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## Q.P. Code :11967

**[Time: 3 Hours]** **[ Marks:80]**

Please check whether you have got the right question paper.

**N.B:**
1. **Question No.1 is compulsory.**
2. **Attempt any three questions out of remaining five.**
3. Assume suitable data if required.

Q.1 Answer the following 20

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

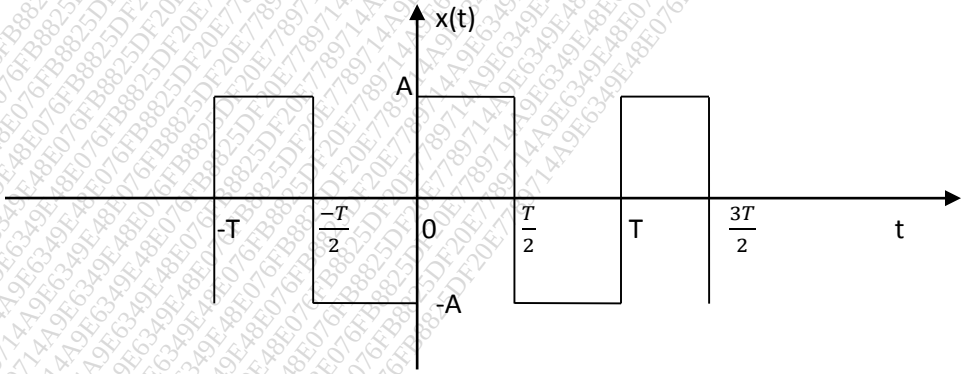
b) Determine if following system is memoryless, casual, linear, time invariant.
   $y(t)=10\, x(t) + 5$

c) Determine Fourier transform of x(t) using time shifting property
   $x(t) = e^{-3|t-t_0|} + e^{3|t+t_0|}$

d) Find out even and odd components of the following signals:
   (i) $x[n] = u[n] - u[n-5]$
   (ii) $x(t) = 3+2t+5t^2$

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

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




Q.2 b) Find impulse response of continuous time systems governed by following transfer function. 10

(i) $H(s) = \frac{1}{s^2(s-2)}$

(ii) $H(s) = \frac{1}{s(s+1)(s-2)}$

Q.3 a) A continuous time signals is defined as, 10

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

$x(t) = 0; \quad t > 3$



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**Q.P. Code :11967**

Sketch waveforms of following signals:
(i) x(-t) (ii) x(2-t) (iii) x(3t) (iv) x(0.5t+1)

Q.3 b) Determine inverse z-transform of the following function: 05
$X[Z] = \log(1+az^{-1}); |z| > |a|$

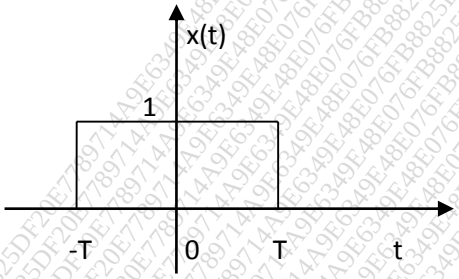
Q.3 c) Compute DTFT of sequence x[n] = {0, 1, 2, 3}. Also Sketch magnitude and phase spectrum. 05

Q.4 a) Using Laplace Transform determine complete response of system described by following equation. 10
$\frac{d^2y(t)}{dt^2} + 5\frac{dy(t)}{dt} + 4\,y(t) = \frac{dx(t)}{dt}$ where y(0) = 0; $\frac{dy(t)}{dt}|_{t=0}$=1, for input x(t) $e^{-2t}$ u(t)

Q.4 b) Find impulse response of system described by following difference equation 10
y[n] – 3y[n-1] -4y[n-2] = x[n]+2x[n-1] where all initial conditions are zero.

Q.5 a) For the following continuous time signals, determine Fourier Transform. 10
(i) $x(t) = e^{-at} \sin\omega_0 t\, u(t)$

(ii)




Q.5 b) Determine Fourier series representation of $x[n] = 4\cos[\frac{\pi n}{2}]$ 05

Q.5 c) Determine cross correlation of sequence x[n] = {1, 1, 2, 2} and y[n] = {1, 3, 1} 05

Q.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
(i) $x[n] = a^n u[n-1]$ 05
(ii) $x[n] = a^n \cos\omega_0 n\, u[n]$ 05

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**QP CODE : 22625**

**(3 Hours)** **Marks: 80**

**N.B.:** (1) Question No.**1** is **compulsory**.
(2) Solve any **three** questions from **remaining five** questions.
(3) Figures to the right indicate full marks.
(4) Assume suitable data if required and mention the same in the answer sheet.

Q.1 Solve any **five** of the following: - 20

(a) What is cross over distortion? How to overcome the same.

(b) Consider a BJT has parameters $f_T$ =500MHz at $I_C$ = 1mA, $\beta$ = 100 and $C\mu$ = 0.3pF. Calculate bandwidth of $f_\beta$ and capacitance $C\pi$ of a BJT.

(c) Implement $Vo = -(3V_1 + 4V_2 + 2V_3)$ using OpAmp.

(d) Define the CMRR of Differential Amplifier. Why constant current source biasing is preferred for Differential Amplifier?

(e) Draw the circuit diagram of widlar current source and derive the relationship between output current and reference current.

(f) A zener voltage regulator as shown in **Fig. 1f** has $V_Z$ = 6.2V. The input voltage varies from 10 V to 15 V and load current is 60 mA. To hold output voltage constant under all conditions what should be the range of series resistance ($R_{Smin}$ and $R_{Smax}$) ($I_{Zmin}$ = 10 mA, $P_{Zmax}$ = 2W).

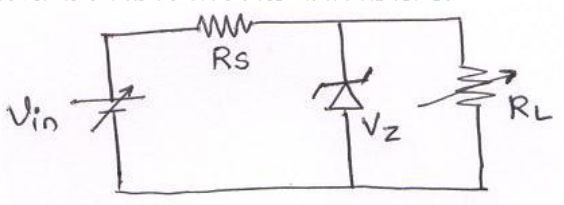


**Fig. 1f**

Q.2 (a) Determine the corner frequency and maximum gain of a bipolar common-emitter circuit shown in **Fig. 2a**, with an input coupling capacitor. 10



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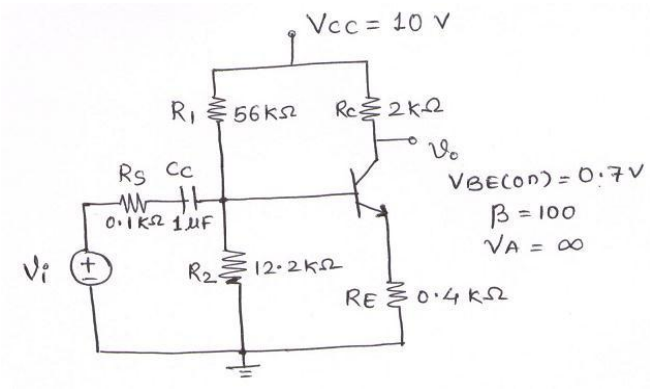


**Fig. 2a**

(b) Draw the circuits of OpAmp based integrator circuit and derive the expression for output voltage. What are the limitations of integrator circuit and how to overcome the limitations? 10

Q.3 (a) Draw the small signal equivalent circuit of the bipolar differential amplifier. Determine its output voltage in the general form for one sided output $V_O = A_d V_d + A_{cm} V_{cm}$, and hence the expressions for differential mode gain and common mode gain. 10

(b) For the circuit shown in **Fig. 3b**, Transistors parameters are $K_n = 1mA/V^2$, $V_{TN} = 0.7V$, $C_{gs} = 2pF$, $C_{gd} = 0.2pF$, $\lambda = 0$. Find the miller capacitance, mid band voltage gain and upper cut off frequency. 10

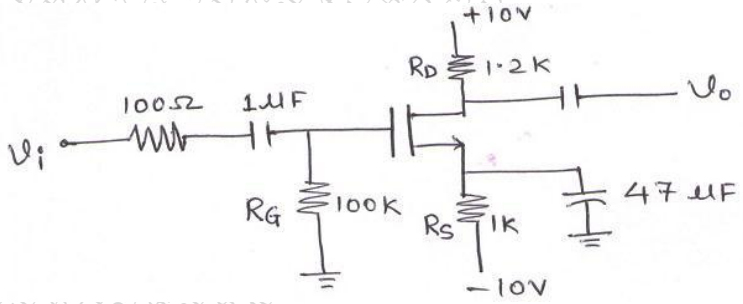


**Fig. 3b**

Q.4 (a) For the MOSFET differential amplifier shown in **Fig. 4a**, the transistor parameters are $K_{n1} = K_{n2} = 0.1$ mA/V$^2$, $K_{n3} = K_{n4} = 0.3$ mA/V$^2$, $V_{TN} = 1V$ for all transistors, $\lambda = 0$ for $M_1$, $M_2$ and $M_3$, $\lambda = 0.01$ V$^{-1}$ for $M_4$. Determine the bias current $I_Q$, output resistance of current source, differential-mode voltage gain, common-mode voltage gain and CMRR for the differential amplifier. 10



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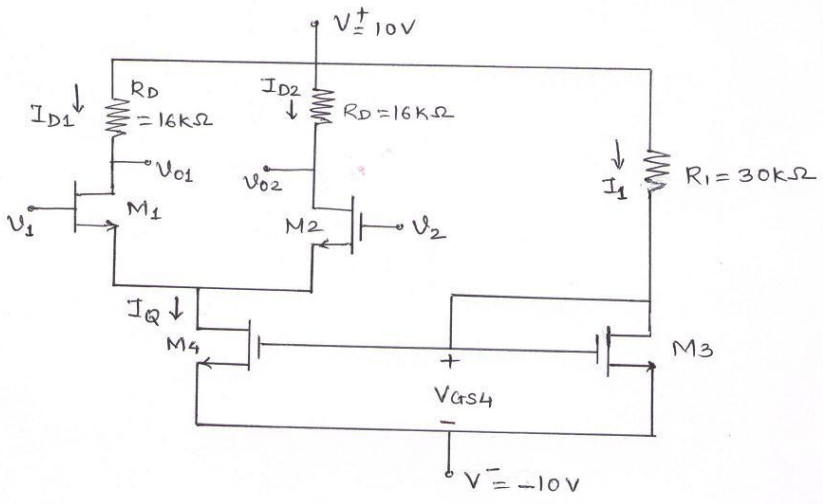


**Fig. 4a**

(b) Draw circuit diagram of cascode amplifier using BJT and derive expression for voltage gain, input resistance and output resistance. 10

Q.5 a) Draw and explain the working of Class A power amplifier (transformer coupled). Derive the expression for efficiency. 10

(b) For the basic three transistor current source shown in **Fig. 5b**, the parameters are : 10

$V^+ = 10V$, $V^- = 0V$ and $R_1 = 12K\Omega$, for all transistors $V_{BE\ (on)} = 0.7V$, $\beta=100$ and $V_A = \infty$. Calculate value of each current shown in Fig. , i.e. $I_{REF}$, $I_{C1}$, $I_{B1}$, $I_{B2}$, $I_{E3}$, $I_{B3}$.

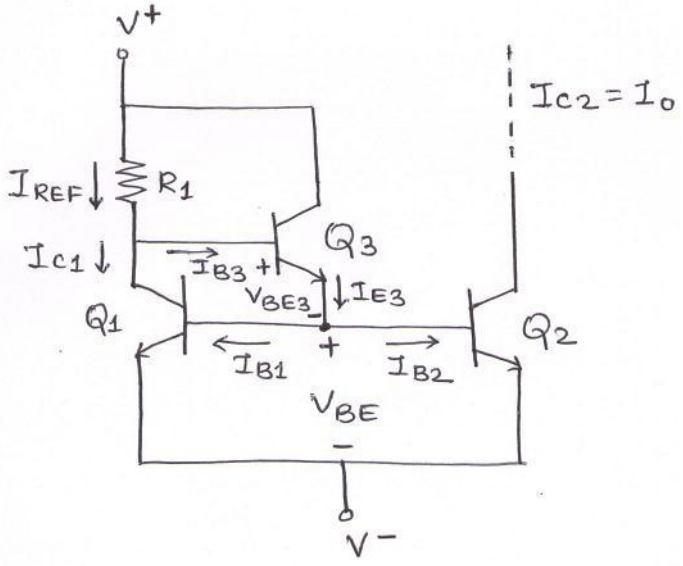


**Fig. 5b**



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Q.6 Write short notes on any **four** of the following :- 20

(a) Millers Theorem.

(b) Active Filters.

(c) Transistorized series regulator

(d) Wilson current source.

(e) Power MOSFET.

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Q.P.Code: 24738

(3 Hours) Max Marks: 80

**Note:**
1. **Question No. 1 is compulsory.**
2. **Out of remaining questions, attempt any three questions.**
3. **Assume suitable additional data if required.**
4. **Figures in brackets on the right hand side indicate full marks.**

**1. (A)** Explain interrupt pins of 8085. **(05)**

**(B)** Explain string addressing mode of 8086 **(05)**

**(C)** Explain memory segmentation of 8086. **(05)**

**(D)** Write control word of 8255 to initialize port A as input port, port B and C as output port, Group A and B in mode 0. **(05)**

**2. (A)** Draw and explain timing diagram for read operation of 8086 in minimum mode. **(10)**

**(B)** Write a program to set up 8253 as square wave generator with 1 ms period if input frequency of 8253 is 1 MHz. **(10)**

**3. (A)** Draw and explain interfacing of ADC 0808 with 8086 microprocessor using 8255. **(10)**

**(B)** Explain 8086 interrupt structure. **(10)**

**4. (A)** Describe in brief architecture of 80286 microprocessor **(10)**

**(B)** Explain Modes of 8254 Timer/Counter peripheral IC with the help of timing diagram. **(10)**

**5. (A)** Draw and Explain interfacing of Math co-processor with 8086. **(10)**

**(**B) Explain interfacing of 8086-8259 **(10)**

**6. (A)** Explain interfacing of 8086 with 8257 DMA controller. **(10)**

**(B)** Explain how 64 KB EPROM can be interfaced with 8086 that operates at frequency of 10 MHz using 8 KB device. **(10)**

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