GRT INSTITUTE OF ENGINEERING AND TECHNOLOGY, Tiruttani.

(Approved by AICTE, New Delhi, Affiliated to Anna University, Chennai**.)**

Department of Electronics & Communication Engineering
II Year - III Semester

ANNA UNIVERSITY, CHENNAI AFFILIATED INSTITUTIONS

Regulation-2013

MINIMUM LEARNING MATERIAL

SEMESTER III COURSES

SL. No.	COURSE CODE	COURSE TITLE	L	T	P	C
THEORY						
1.	MA6351	Transforms and Partial Differential Equations	3	1	0	4
2.	EE6352	Electrical Engineering and Instrumentation	3	1	0	4
3.	EC6301	Object Oriented Programming and Data Structures	3	0	0	3
4.	EC6302	Digital Electronics	3	0	0	3
5.	EC6303	Signals and Systems	3	1	0	4
6.	EC6304	Electronic Circuits- I	3	1	0	4

MA 6351 - TRANSFORMS & PARTIAL DIFFERENTIAL EQUATIONS

UNIT – I PARTIAL DIFFERENTIAL EQUATIONS 9+3

Formation of partial differential equations by elimination of arbitrary constants and arbitrary functions –Solutions of standard types of first order partial differential equations - Lagrange‘s linear equation – Linear partial differential equations of second and higher order with constant coefficients.

UNIT - II FOURIER SERIES 9+3

Dirichlet‘s conditions – General Fourier series – Odd and even functions – Half range sine series – Half range cosine series – Complex form of Fourier Series – Parseval‘s identify – Harmonic Analysis.

UNIT – III APPLICATION OF PARTIAL DIFFERENTIAL EQUATIONS 9+3

Classification of Second order Quasi linear partial differential equations - Solutions of one dimensional wave equation – One dimensional heat equation – Steady state solution of two-dimensional heat equation (Insulated edges excluded) – Fourier series solutions in Cartesian coordinates.

UNIT – IV FOURIER TRANSFORM 9+3

Fourier integral theorem (without proof) – Fourier transform pair – Sine and Cosine transforms – Properties – Transforms of simple functions – Convolution theorem – Parseval‘s identity.

UNIT – V Z – TRANSFORM AND DIFFERENCE EQUATIONS 9+3

Z-transforms - Elementary properties – Inverse Z-transform – Convolution theorem -Formation of difference equations – Solution of difference equations using Z-transform.

LECTURES: 45 TORIAL: 15 TOTAL PERIODS: 60

TEXT BOOKS:

1. Grewal, B.S., ―Higher Engineering Mathematics‖, Thirty Sixty Edition, Khanna Publisher, Delhi, 2001.
2. Kandasamy, P., Thilagavathy, K., and Gunavathy, K., ―Engineering Mathematics Volum III‖, S. Chand & Company ltd., New Delhi, 1996.
3. Wylie C. Ray and Barrett Louis, C., ―Advanced Engineering Mathematics‖, Sixth Edition, McGraw – Hill, Inc., New York, 1995.

REFERENCES:

1. Andrews, L. A., and Shivamoggi B. K., ―Integral Transforms for Engineers and Applied Mathematicians,‖ Macmillen, New York, 1988.
2. Narayanan, S., Manicavachagom Pillay, T. K. and Ramaniah, G., ―Advanced Mathematics for Engineering Students‖, Volumes II and III, S. Viswanathan (Printers and Publishers) Pvt. Ltd. Chennai,2002.
3. Churchill, R.V. and Brown, J.W., ―Fourier Series and Boundary Value Problems‖, Fourth Edition, McGraw-Hill Book Co., Singapore, 1987

Unit – I
PARTIAL DIFFERENTIAL EQUATIONS
Part - A

1. Form a partial differential equation by eliminating the arbitrary constants a and b from the equation.

$$(x-a)^2+(y-b)^2 = z^2 \cot^2 \alpha$$

Solution:

Given $(x-a)^2 + (y-b)^2 = z^2 \cot^2 \alpha$ .....(1)

Partially differentiating w.r.t. 'x' and 'y' we get

$2(x-a) = 2zp\cot^2\alpha$ .....(2)

$2(y-b) = 2zq\cot^2\alpha$ .....(3)

(2) => $x-a = zp\cot^2\alpha$ .....(4)

(3) => $y-b = zq\cot^2\alpha$ .....(5)

Substituting (4) and (5) in (1) we get

$z^2p^2\cot^4\alpha + z^2q^2\cot^4\alpha = z^2\cot^2\alpha$

$z^2\cot^4\alpha[p^2 + q^2] = z^2\cot^2\alpha$

$p^2 + q^2 = \frac{1}{\cot^2\alpha} \Rightarrow p^2 + q^2 = \tan^2\boldsymbol{\alpha}.$

2. Find the partial differential equation of all spheres whose centres lie on the x-axis.

Solution:

The equation of a sphere whose center is (a,0,0) (lies on the x-axis) and whose radius is b is

$(x-a)^2 + y^2+z^2 = b^2$ .....(1)

Here ,we have two arbitrary constants 'a' and 'b'.

Partially differentiating (1) with respect to 'x' and 'y'.

we get, $2(x-a) + 2zp = 0$ .....(2)

$2y + 2zq = 0$ .....(3)

(3) => $y + z q = 0$.

Which is the required partial differential equation.

3. Form the partial differential equation by eliminating the arbitrary constants from $z=(x^2+a)(y^2+b)$.

Solution:

Given $z=(x^2+a)(y^2+b)$ .....(1)

Here ,we have two arbitrary constants'a'and 'b'

Differentiating (1) partially w.r.t 'x' and 'y' we get,

$\frac{\partial z}{\partial x} = p = 2x(y^2+b)$ .....(2)

$\frac{\partial z}{\partial y} = q = 2y(x^2+a)$ ....(3)

From (2) we get , $\frac{p}{2x} = y^2 + b$ .....(4)

From (3) we get, $\frac{q}{2y} = x^2+a$ .....(5)

Substituting (4) and (5) in (1) we get,

$z = \frac{p}{2x} \cdot \frac{q}{2y}$

$pq = 4xyz$

This gives the required partial differential equation.

4. Form the partial differential equation by eliminating the arbitrary function 'f' from $z= e^{ay}f(ax + by)$.

Solution:

Given $z = e^{ay}f(ax +by)$ .....(1)

Differentiating (1) partially w.r.t 'x' and 'y' we get,

$P = \frac{\partial z}{\partial x} = e^{ay} f'(ax + by) \times a$

$\Rightarrow f'(ax + by) = \frac{p}{a e^{ay}}$ .....(2)

$q = \frac{\partial z}{\partial y} = e^{ay} f'(ax + by) \times b + f(ax+by) .e^{ay} a$ .....(3)

from(1), $f(ax + by) = \frac{z}{e^{ay}\, a}$ .....(4)

Substituting (2) and (4) in (3), we get,

$q = be^{ay} \times \frac{p}{e^{ay}} + \frac{z}{e^{ay}} . e^{ay} . a \quad \Rightarrow \quad q = \frac{b}{a} p + az$

5. Form a partial differential equation by eliminating the arbitrary function 'g' from the relation $z = x^2 + 2g\left(\frac{1}{y} + \log x\right)$.

Solution:

Given $z = x^2 + 2g\left(\frac{1}{y} + \log x\right)$ .....(1)

Here, we have to eliminate the only arbitrary function 'g'.

For, differentiating (1) partially w.r.t,' x' and 'y' we get ,

$\frac{\partial z}{\partial x} = 2x + 2g'\left(\frac{1}{y} + \log x\right)\frac{1}{x}$

$p = 2x + \frac{2}{x} g'\left(\frac{1}{y} + logx\right)$ .....(2)

$\frac{\partial z}{\partial y} = 2g'\left(\frac{1}{y} + logx\left(-\frac{1}{y^2}\right)\right)$

$q = -\frac{2}{y^2} g'\left(\frac{1}{y} + logx\right)$ .....(3)

$2g'\left(\frac{1}{y} + logx\right) = -qy^2$

Substituting (3) in (2) we get ,

$p = 2x - \frac{qy^2}{x}$ Simplifying we get, $px + qy = 2x^2$.

6. Form the PDF by eliminating 'f' from $f(xy + z^2, x + y + z) = 0$

Solution:

Given $f(xy + z^2, x + y + z) = 0$

Let $u = xy + z^2$,$v = x + y + z$

Is of the from $f(u,v) = 0$

The elimination of 'f' from (1) gives,

$$\begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial v}{\partial x} \\ \frac{\partial u}{\partial y} & \frac{\partial v}{\partial y} \end{vmatrix} = 0$$

$$\begin{vmatrix} y + 2zp & 1 + p \\ x + 2zq & 1 + q \end{vmatrix} = 0$$

$(1 + q)(y + 2zp) - (1 + p)(x + 2zq) = 0$

$(2z - x)p + q(y - 2z) = x - y.$

7. Form the partial differential equation by eliminating the arbitrary function 'g'from the relation $g\left(\frac{y}{x}, x^2 + y^2 + z^2\right) = 0$

Solution :

Given $g\left(\frac{y}{x}, x^2 + y^2 + z^2\right) = 0$ .....(1)

Let $u = \frac{y}{x}$ .....(2)

$v = x^2 + y^2 + z^2$ .....(3)

Therefore equation (1) takes the form

$\phi(u,v) = 0$ .....(4)

we know that eliminate of ϕ form (4) gives

$$\begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial v}{\partial x} \\ \frac{\partial u}{\partial y} & \frac{\partial v}{\partial y} \end{vmatrix} = 0 \quad .....(5)$$

From equation (2), $\frac{\partial u}{\partial x} = -\frac{y}{x^2}$,

$\frac{\partial u}{\partial y} = \frac{1}{x}$ .....(6)

From equation (3) , $\frac{\partial v}{\partial x} = 2x + 2zp$

$\frac{\partial v}{\partial y}$ = 2 zq +2y ……..(7)

Substituting (6) and (7) in (5) we get

$$\begin{vmatrix} -\frac{y}{x^2} & 2x + 2zp \\ \frac{1}{x} & 2y + 2zq \end{vmatrix} = 0$$

$(2y + 2zq)(\frac{-y}{x^2})$ - $\frac{1}{x}$ (2x +2zp) = 0 Simplifying we get, $x$zp +yzq + x^2 +y^2 = 0.

8. Solve the equation: pq + p + q = 0

Solution:

This equation contains only p and q

It is of the type F (p,q) = 0

Given pq + p +q =0 …….(1)

Let us assume the solution to be z = a$\boldsymbol{x}$ +by +c …..(2)

Partially differentiating (2) w.r.t '$\boldsymbol{x}$' and 'y'. we get,

$\frac{\partial z}{\partial x}$ = a , $\frac{\partial z}{\partial y}$ = b

=> $\mathbf{p = a, q = b}$ …….(3)

Substituting (3)in (1), we get, ab + a + b = 0 ……(4)

hence , z = a$\boldsymbol{x}$ + by + c is the solution of (1)

(4) => b = $\frac{-a}{a+1}$

Substituting (5) in (2) , we get,

Z = a$\boldsymbol{x}$ -$\frac{a}{a+1}$ y + c

Which is complete integral of (1).

There is no singular integral for this type.

9. Solve p^2+q^2=4

Solution:

Given: P^2+q^2=4

This is of the type F (p,q)=0 ……. …(1)

Let us assume the solution to be z=a$\boldsymbol{x}$+by+c=0 ….(2)

Partially differentiating (2) w.r.t '$\boldsymbol{x}$' and'y',we get,

$\frac{\partial z}{\partial x}$ =a , $\frac{\partial z}{\partial y}$ =b

=> p=a and q=b …….(3)

substituting (3) in (1).we get, a^2+b^2=4

hence z=a$\boldsymbol{x}$+by+c is the solution of (1) …….(4)

To get complete intergral we have to eliminate any one of the arbitrary constants from (2). (therefore for complete integral we should have equal number of arbitrary constants and independent variables).

From (4) we get b=±$\sqrt{\mathbf{4 - a^2}}$ …….(5)

substituting (5)in(2) we get, z=a$\boldsymbol{x}$±y$\sqrt{\mathbf{4 - a^2}}$ +c which contains only two constants (equal to the number of independent variables) therefore it gives the complete intergral.

To find singular intergral:

The complete integral is

z=a$\boldsymbol{x}$±$\sqrt{\mathbf{4 - a^2}}$ y+c …(6)

Differentiating (6) partially w.r.t, a and c equating to zero,

We get

$\frac{\partial z}{\partial a}$ =x±$\frac{1}{2\sqrt{4-a^2}}$(-2a)=0 …(7)

and $\frac{\partial z}{\partial c}$=1=0. Here 1=0 is not possible.

Hence there is no singular integral.

10. Find the singular solution of the equation Z = px + qy + p^2 + pq + q^2 …….(*)

Solution :

The complete solution of (*) is

$z = ax + by + a^2 + ab + b^2$ [where p=a and q =b] ……..(1)

Partially differential w,r,to 'a' and 'b', we get

$\frac{\partial z}{\partial a} = x + 2a + b = 0$ ……(2)

$\frac{\partial z}{\partial b} = y + a + 2b = 0$ ……(3)

Eliminate 'a' and 'b' from (1),(2) and (3).we get the singular integral From (2),we get,

$a = \frac{-(x+b)}{2}$ ……(4)

Substituting (4) in (3), we get,

$y - \frac{(x+b)}{2} + 2b = 0$

$y - \frac{x}{2} - \frac{b}{2} + 2b = 0$

$y - \frac{x}{2} + \frac{3}{2} b = 0$

$\frac{3}{2} b = \frac{x}{2} - y$

$b = \frac{x-2y}{3}$ ……(5)

substituting (5) in (4),we get,

$a = -\frac{1}{2}[x + \frac{x-2y}{3}] = -[\frac{4x-2y}{6}] = -\left[\frac{2x-y}{3}\right]$ ……(6)

Substituting (5)and (6) in (1), we get, $z = \left(-\left[\frac{2x-y}{3}\right]\right)x + \left(\frac{x-2y}{3}\right)y + \left(-\left[\frac{2x-y}{3}\right]\right)^2 + \left(-\left[\frac{2x-y}{3}\right]\right)\left(\frac{x-2y}{3}\right) + \left(\frac{x-2y}{3}\right)^2$

$3z = xy - x^2 - y^2$ which is the S.I.

11. Solve: $z = px + qy + 2\sqrt{pq}$.

Solution:

This is of type (2), $z = px + qy + f(p,q)$

Let $z = ax + by + 2\sqrt{ab}$ …..(1) be the complete solution of the given equation.

Then p = a, q = b. substituting p = a and q =b then the given equation is satisfied .Hence equation (1) is the complete solution of the given partial differential equation. Therefore $z = ax + by + 2\sqrt{ab}$ is the complete integral.

To find singular integral:

Equation (1) Partially differentiating w.r.t. 'a' and 'b' and then equating to zero, we get,

$\frac{\partial z}{\partial a} = x + \sqrt{\frac{b}{a}} = 0$ i.e., $x = -\sqrt{\frac{b}{a}}$ ……..(2)

$\frac{\partial z}{\partial b} = y + \sqrt{\frac{a}{b}} = 0$ i.e., $y = -\sqrt{\frac{a}{b}}$ ……..(3)

Eliminating 'a' and 'b' from (2) and (3) we get $xy = 1$ which is the singular integral.

12. Find the singular integral of the partial differential equation $z = px + qy + p^2 - q^2$

Solution:

This is of the type $z = px + qy + f(p,q)$

The complete integral is

$z = ax + by + a^2 - b^2$ ……(1)

Now, $\frac{\partial z}{\partial a} = x + 2a = 0$

$\Rightarrow a = \frac{-x}{2}$ ……(2)

$\frac{\partial z}{\partial b} = y - 2b = 0$

$\Rightarrow b = \frac{y}{2}$ …….(3)

Substituting (2)and (3)in (1), we get

$z = \frac{-x^2}{2} + \frac{y^2}{2} + \frac{x^2}{4} - \frac{y^2}{4} = \frac{-x^2}{4} + \frac{y^2}{4}$

i.e., $y^2 - x^2 = 4z$ which is the S.I.

13. Solve $z^2 = p^2 + q^2 + 1$.

Solution:

This equation does not contain x and y.

Hence this is of the type F(z,p,q)=0.

Given $z^2=p^2+q^2+1$ ...(1)

Let z = f (x+ay) be the solution of (1)

Put x+ay =u

=> z=f(u)

$p=\frac{dz}{du}$, $q=a\frac{dz}{du}$ .....(2)

Substituting (2)in (1), we get ,

$z^2=\left(\frac{dz}{du}\right)^2+a^2\left(\frac{dz}{du}\right)^2+1$

$\left(\frac{dz}{du}\right)^2(1+a^2)=z^2-1$

$\left(\frac{dz}{du}\right)^2=\frac{z^2-1}{(1+a^2)}$

$\frac{dz}{du}=\frac{1}{\sqrt{1+a^2}}\sqrt{z^2-1}$

Using variable separable method and Intergrating both sides, we get,

$\int\frac{dz}{\sqrt{z^2-1}}=\int\frac{du}{\sqrt{1+a^2}}$

$\text{Cosh}^{-1}z=\frac{1}{\sqrt{1+a^2}}u+b$

$\text{Cosh}^{-1}z=\frac{1}{\sqrt{1+a^2}}(x+ay)+b$.

Which is the complete integral .

14. Solve $z = p^2 + q^2$

Solution:

This is of the type F (z , p , q) = 0

Given $z = p^2 + q^2$ .....(1)

Assume that z = f (x + ay) .....(2)

Is a solution (1) .put x +ay = u in (2)

z = f (u) .....(3)

Partially differentiating (3) w.r.t. 'x' and 'y'. we get,

$p=\frac{dz}{du}$; $q=a\frac{dz}{du}$ .....(4)

Substituting (3) in (1) we get,

$z=\left(\frac{dz}{du}\right)^2+a^2\left(\frac{dz}{du}\right)^2$

i.e., $\left(\frac{dz}{du}\right)^2(1+a^2)=z$

i.e., $\frac{dz}{du}=\frac{\sqrt{z}}{\sqrt{1+a2}}$

Using variable separable method.

i.e., $\frac{dz}{\sqrt{z}}=\frac{du}{\sqrt{1+a2}}$ .....(5)

Integrating (5) we get,

$2\sqrt{z}=\frac{u}{\sqrt{1+a2}}+b$

$2\sqrt{z}=\frac{x+ay}{\sqrt{1+a2}}+b$

$2\sqrt{z}=\frac{x+ay+b\sqrt{1+a2}}{\sqrt{1+a2}}$

Squaring both sides, we get,

i.e., $4(1+a^2)z=\left(x+ay+b\sqrt{1+a2}\right)^2$

which is the equation of family of parabolic cylinders.

Taking partial derivative w.r.t. 'a' and 'b', we get,

8az = 2 (x + ay + b) y = 0

x + ay +b = 0

Eliminating 'a' and ' b' from these two equations , we get the singular integral z = 0.

15. Solve q = p x + p^2

Solution :

This is of the type F_1 (x,p) = F_2(q,y)

Let q = p x + p^2 = $\frac{k^2}{4}$ (constant)

(Here assuming the constant as $\frac{k^2}{4}$ is only for convenience)

i.e., q = $\frac{k^2}{4}$; p^2 + p x - $\frac{k^2}{4}$ = 0 (which is the quadratic equation in p)

i.e., q = $\frac{k^2}{4}$ .....(1)

p = $\frac{-x\pm\sqrt{x^2+k^2}}{2}$ .....(2)

We know that dz = p dx + q dy .....(3)

Substituting (1) and (2) in (3) we get ,

dz = ($\frac{-x\pm\sqrt{x^2+k^2}}{2}$) d x + $\frac{k^2}{4}$ dy

Integrating we get, $\int dz = \int\left(\frac{1}{2}\left(-x \pm \sqrt{x^2+k^2}\right)\mathrm{d}\,x\right) + \int\left(\frac{k^2}{4}\right)\mathrm{dy}$

z = $\frac{-x^2}{4}\pm\frac{1}{2}\left\{\frac{x}{2}\sqrt{x^2+k^2} + \frac{k^2}{2}sin^{-1}\left(\frac{x}{k}\right)\right\}$ + $\frac{k^2y}{4}$ + b

16. Solve : yp = 2y x + log q.

Solution :

This equation can be reduced to the type f_1 (x,p) = f_2 (y,q).

Given yp =2y x + log q

i.e.,y(p – 2 x) = log q

p – 2x = $\frac{\log q}{y}$ = k

i.e., p – 2x = k ; log q – ky = 0

p = 2x + k ; q = e^{ky} .....(1)

We know that dz = p dx + q dy .....(2)

Substituting (1) in (2). We get, dz = (2x + k)d x + e^{ky} dy

Integrating both sides, we get, z = $\int(2x + \mathrm{k})$ d x + $\frac{e^{ky}}{k}$ +c

z = $x^2 + kx$ + $\frac{e^{ky}}{k}$ +c

Which is the complete integral .

17. Solve ($D^3 - 3DD'^2 + 2D'^3$)z=0

Solution:

The auxiliary equation is $m^3 - 3m + 2 = 0$

m =1,1,-2.

The solution of C.F is z= f_1(y+ x) + x f_2(y+ x)+ f_3(y-2 x).

18. Solve ($D^4 - D'^4$)z=0

Solution:

The auxiliary equation is $m^4 - 1$=0

$(m^2 + 1)(m^2 - 1)$=0

m =$\pm$ 1; m =$\pm i$

The solution of C.F is

z= f_1(y+ x)+f_2(y- x)+ f_3(y-i x) f_4(y-i x).

19. Solve$\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x\partial y}$+ 6$\frac{\partial^2 z}{\partial y^2}$=$e^{x+y}$

Solution:

The given equation can be written as (D^2-5DD'+6D'^2)z=e^{x+y}

To find the complementary function :

The auxiliary equation m^2-5 m +6=0

=> m = 2,3.

Then the C.F is $z=f_1(y+2x)+f_2(y+3x)$.
To find the particular integral:

$$P.I=\frac{1}{D^2-5DD'+6D'^2}e^{x+y}$$

[Replace D by 1 and D' by 1]

$$=\frac{1}{1-5+6}e^{x+y}$$

$$=\frac{1}{2}e^{x+y}.$$

The complete solution is z=C.F+P.I This implies that $Z=f_1(y+2x)+f_2(y+3x)+\frac{1}{2}e^{x+y}$.

20. Solve $(D^2+3DD'-4D'^2)z=\sin y$

Solution:

The auxiliary equation is $m^2+3m-4=0 \Rightarrow m=1,-4$

Then the C.F is $z=f_1(y+x)+f_2(y-4x)$

To find P.I:

$$P.I=\frac{1}{D^2+3DD'-4D'^2}\sin y \quad =\frac{1}{4}\sin y$$

$$z=f_1(y+x)+f_2(y-4x)+\frac{1}{4}\sin y.$$

21. Solve $(D^2-2DD')z=x^3y$

Solution:

The auxiliary equation is $m^2-2m=0$

$m=0,2.$

Then the C.F is $z=f_1(y)+f_2(y+2x)$.

To find P.I:

$$P.I=\frac{1}{D^2-2DD'}x^3y$$

$$=\frac{1}{\left(D^2\left(1-\frac{2D'}{D}\right)\right)}x^3y$$

$$=\frac{1}{D^2}\left(1-\frac{2D'}{D}\right)^{-1}x^3y$$

$$=\frac{1}{D^2}\left[1+\frac{2D'}{D}+\frac{4D'^2}{D^2}+\ldots\ldots\ldots\right]x^3y \quad \text{[higher order omitting]}$$

$$=\frac{1}{D^2}\left[x^3y+\frac{2x^3}{D}\right]$$

$$=\frac{1}{D^2}(x^3y)+\frac{2}{D^3}(x^3)$$

$$=\frac{x^5y}{20}+\frac{x^6}{60}$$

The complete solution is $z=f_1(y)+f_2(y+2x)+\frac{x^5y}{20}+\frac{x^6}{60}$.

22. Solve $(D^3-2D^2D')z=0$

Solution:

The auxiliary equation is $m^3-2m^2=0$

$m^2(m-2)=0$

$m=0,0,2.$

Then the complementary function is

$z=f_1(y)+xf_2(y)+f_3(y+2x)$.

23. Form the PDE by eliminating the arbitrary constants a and b from $(x-a)^2+(y-b)^2+z^2=1$

Solution:

Given $(x-a)^2+(y-b)^2+z^2=1$ .....(1)

Partially differention (1) w.r.t 'x' and 'y' we get,

$2(x-a)+2zp=0 \Rightarrow (x-a)=-zp$....(2)

$2(y-b)+2zq=0 \Rightarrow (y-b)=-zq$....(3)

Substituting (2) and (3) in(1) we get,

$$z^2p^2+z^2q^2+z^2=1$$

$$p^2+q^2+1=\frac{1}{z^2}$$

24. Form the PDE by eliminating the arbitrary function from $\varphi(z^2-xy,\frac{x}{z})$=0

Solution:

Given $\varphi(z^2-xy,\frac{x}{z})$=0…(1)

Let u=z^2-xy and v=$\frac{x}{z}$

Then the given equation is of the form $\varphi(u,v)=0$ …..(2)

The elimination of the form equation (2), we get,

$$\begin{vmatrix} \frac{\partial u}{\partial x} & \frac{\partial v}{\partial x} \\ \frac{\partial u}{\partial y} & \frac{\partial v}{\partial y} \end{vmatrix} = 0$$

$$=> \begin{vmatrix} 2zp-y & \frac{z-px}{z^2} \\ 2zq-x & \frac{-xq}{z^2} \end{vmatrix} = 0$$

$x^2p-q(xy-2z^2)$=zx.

25. Find the singular solution of the PDE z=px+qy+p^2-q^2.

Solution:

This is of the type z=px+qy+f(p,q)…(1)

The complete integral is z=ax+by+a^2-b^2

Now $\frac{\partial z}{\partial a}$ =x+2a=0=>a=$\frac{-x}{2}$…..(2)

$\frac{\partial z}{\partial b}$ =y-2b=0=> b=$\frac{y}{2}$…..(3)

Substituting (2) and (3) in(1) we get,

4z=y^2-x^2 which is the singular integral.

UNIT II
FOURIER SERIES
PART – A

1. State the Dirichlet's condition for Fourier series.

(i) f(x) is defined and single valued except possibly at a finite number of points in $(-\pi,\pi)$

(ii). f(x) is periodic with period 2 π

(iii). f(x) and $f'(x)$ are piecewise continuous in $(-\pi,\pi)$ then the fourier series of f(x) converges to

(a). f(x) if x is a point of continuity

(b). $\frac{f(x+a)+f(x-0)}{2}$ if x is point of discontinuity.

2. What do you mean by harmonic analysis?

The process of finding the Fourier series for a function given by numerical value is known as harmonic analysis the Fourier coefficient a_0 and b_0 of the function y =f(x) in (0,2 π) are given by,

a_0 =2(mean value of y in (0,2 π)

b_0 =2(mean value of y cosnx in (0,2 π)

b_n =2(mean value of y sinnx in (0,2 π)

3. Define the root mean square value of a function f(x) in (0,2 π)

$$\text{R.M.S} = \sqrt{\frac{\int_0^{2\pi} [f(x)]^2 \, dx}{2\pi}}$$

4. If f(x) is an odd function of x in $(-l,l)$, what are the values of a_0 and b_0 in the fourier seies of f(x)?

Give f(x) is an odd function of x in $(-l,l)$.

By the property $a_0 = 0$, $a_n = 0$

5. Write down the complex form of the fourier series for f(x) in $(c, c+2\pi)$.

$$f(x) = \sum_{n=-\infty}^{\infty} c_n e^{inx} \qquad c_n = \frac{1}{2\pi} \int_c^{c+2\pi} f(x) e^{-inx} dx$$

6. Write down the form of the Fourier series of an odd function in $(-l,l)$ and the associated Euler's formulae for the Fourier coefficient.

$$f(x) = \sum_{n=-\infty}^{\infty} b_n \sin \frac{n\pi x}{l}$$

Where $b_n = \frac{1}{l} \int_l^{-l} f(x) \sin \frac{n\pi x}{l} dx$

7. Find the constant term in the expansion for $\cos^2 x$ as a fourier series in the interval $(-\pi, \pi)$
Constant term is 1.

$$a_0 = \frac{1}{\pi} \int_{-\pi}^{\pi} \left(\frac{1+\cos 2x}{2} \right) dx$$

$$a_0 = \frac{1}{2\pi} \left[1 + \frac{\sin 2x}{2} \right]_{-\pi}^{\pi} = 1$$

8.Find the sum of the Fourier series for $f(x) = \begin{cases} x & 0 < x < 1 \\ 2 & 1 < x < 2 \end{cases}$ $at x = 1$ X=1 is a point of discontinuity.

$$f(x) = \frac{f(1+0) + f(1-0)}{2} = \frac{2+1}{2} = \frac{3}{2}$$

9. Determine the value of b_n in the fourier series expansion of $x \sin x$ in $(-\pi, \pi)$

$b_n = 0$ since $x \sin x$ is an even function in the $(-\pi, \pi)$

10. Find the sum of the fourier of $f(x) = x + x^2 in - \pi < x < \pi$. At $x = \pi$.

Given $f(x) = x + x^2 in - \pi < x < \pi$

The sum of fourier series is equal to the arithmetic mean of the value of f(x) at $x = \pi$ and $x = -\pi$ i.e Sum of the fourier series

$$f(x) = \frac{f(\pi) + f(-\pi)}{2} = \frac{\pi + \pi^2 - \pi + \pi^2}{2} = \pi^2$$

11. If f(x) is an odd function defined in $(-l,l)$. What are the value of a_0 and a_n ?

$a_n = 0, a_0 = 0$, since f(x) is an odd function.

12. State Parseval's identity for the half range cosine expansion of f(x) in (0,1).

$$2\int_0^1 [f(x)]^2 \, dx = \frac{a_0^{\,2}}{2} + \sum_{n=1}^{\infty} a_n^{\,2}$$

$$a_0 = 2\int_0^1 f(x)dx$$

$$a_n = 2\int_0^1 f(x)\cos nx dx$$

13. If $f(x) = \begin{cases} \cos x & if\ 0 < x < \pi \\ 50 & if\ \pi < x < 2\pi \end{cases}$ & $f(x) = f(x+2\pi)$ **for all x, find the sum of the fourier series of f(x) at** $x = \pi$ **.**

Here π is a point of discontinuity.
The sum of the fourier series is equal to the average of right hand and left hand limit of the given function at $x = \pi$

$$f(x) = \frac{f(\pi - 0) + f(\pi + 0)}{2} = \frac{\cos\pi + 50}{2} = \frac{49}{2}$$

14. Find the root mean square value of $f(\mathrm{x}) = \pi - \mathrm{x}, (0, 2\pi)$

RMS value is given by $\frac{1}{2\pi}\int_0^{2\pi}\left[\pi^2 + x^2 - 2\pi x\right]dx = \frac{1}{2\pi}\left[\left[\pi^2 x + \frac{x^3}{3} - 2\pi\frac{x^2}{2}\right]\right] = \frac{\pi^2}{3}$

RMS = $\frac{\pi^2}{3}$

15.Obtain the first term of the fourier series for the function $f(x) = x^2 \quad -\pi < x < \pi$.

Here f(x) is an even function so,

$$a_0 = \frac{1}{\pi}\int_{-\pi}^{\pi} f(x)dx = \frac{1}{\pi}\int_{-\pi}^{\pi} x^2 dx = \frac{2}{\pi}\int_0^{\pi} x^2 dx = \frac{2\pi^2}{3}$$

16.If $f(x) = 3x - 4x^3, -2 < x < 2$ **, then find the value of** a_1 **in the fourier series expansion.**

Given $f(x) = 3x - 4x^3, -2 < x < 2$

$$f(-x) = -3x + 4x^3 = -(3x - 4x^3) = -f(x)$$

Where $a_n = 0 \,\&\, a_1 = 0$

17. Find b_n **in the expansion of** x^2 **as a fourier series in** $-\pi < x < \pi$ **.**

$b_n = 0$, since f(x) is an even function $-\pi < x < \pi$

18. If f(x) is an odd function defined in $(-l, l)$ **what are the values** $a_0 \,\&\, a_n$ **?**

$a_0 = 0 \,\&\, a_n = 0$, since f(x) is an odd function.

19. Find the RMS value of f (x) = 1- x in the interval

$$\bar{y}^2 = \frac{2}{l}\int_0^l (f(x))^2 dx = \frac{2}{1}\int_0^1 (1-x)^2 dx = 2\left[\frac{(1-x)^3}{-3}\right] = \frac{2}{3}$$

20. If f (x) = 2x in the interval (0 , 4) then find the value of a_2 in the Fourier series expansion.

WKT a_n for f (x) in $(0, 2l)$ Here f (x) = 2x, $l = 2$ and n = 2 $a_n = \frac{1}{l}\int_0^{2l} f(x)\cos\left(\frac{n\pi x}{l}\right)dx$

$$a_2 = \frac{1}{2}\int_0^4 2x\cos\left(\frac{2\pi x}{2}\right)dx = \int_0^4 x\cos\pi x\, dx = \left[x\frac{\sin\pi x}{\pi} + \frac{\cos\pi x}{\pi}\right]_0^4 = \frac{1}{\pi^2} - \frac{1}{\pi^2} = 0$$

UNIT – III
APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION
PART – A

1. **State the suitable solution of the one dimensional wave equation.**

$\frac{\partial^2 u}{\partial^2 t} = c^2 \frac{\partial^2 u}{\partial^2 x}$

Where $c^2 = \frac{T}{M}$

$$c^2 = \frac{Tension}{Mass\ per\ unit\ length}$$

2. Write all variable separable solution of the one dimensional wave equation.

The three possible solution of one dimensional wave equation is

i) $u(x,t) = (c_1 e^{px} + c_2 e^{-px})(c_3 e^{pat} + c_4 e^{-pat})$

ii) $u(x,t) = (c_5 cospx + c_6 sinpx)(c_7 cospat + c_8 sinpat)$

iii) $u(x,t) = (c_9 x + c_{10} x)(c_{11} t + c_{12})$

3. What is the best solution of one dimensional wave equation?

$$u(x,t) = (c_1 cospx + c_2 sinpx)(c_3 cospat + c_4 sinpat)$$

4. Write all variable separable solution of the one dimensional heat equation

i) $u(x,t) = (c_1 e^{px} + c_2 e^{-px})e^{tp^2\propto^2}$

ii) $u(x,t) = (c_5 cospx + c_6 sinpx)e^{-tp^2\propto^2}$

Iii) $u(x,t) = (c_1 x + c_2)$

5. State the suitable solution of one dimensional heat equation

$$u(x,t) = (c_1 cospx + c_2 sinpx)e^{-tp^2\propto^2}$$

6. Temperature gradient:

Consider a bar of uniform cross section of length 'x' cm. Let the two ends of the rod are maintained at temperature u_1 and u_2 where $u_1 > u_2$. The quantity $\frac{u_1 - u_2}{x}$ represents the rate of change of temperature with respect to distance is called the temperature gradient is denoted by $\frac{\partial u}{\partial x}$

7. Steady state temperature distribution

The temperature within the solid does not vary with time but vary with positions (i.e.) time derivative of temperature vanishes.

8. Define steady state and write the one dimensional heat equation in steady state.

If the temperature will not change when time varies is called steady state temperature distribution. In steady state, the temperature depends only on distance x and one dimensional heat equation becomes $\frac{\partial^2 y}{\partial^2 x} = 0$

9. The ends A and B of a rod 30cm long have their temperature kept at $20^o c$ and $80^o c^{\cdot}$ Until steady state condition prevails. Find the initial temperature distribution for the subsequent motion.

Solution:

Steady state equation is ,

u(x) = ax +b **(1)**

Put x=0, u=20

20=0 +b

b=20

Put x=30, u=80 80 =30a+ 20

30a=60

a= 2

Substitute 'a' and 'b' values in (1) we get, **u(x)= 2x+20**

10. How many conditions are required to solve $\frac{\partial u}{\partial t} = c^2 \frac{\partial^2 u}{\partial^2 x}$

Solution:

Two boundary conditions and one initial condition,

i) u(0,t)=0,

ii) u(l, t) =0 for all $t \geq 0$

iii) u(x,0)=f(x)

11. Classify the following partial differential equations

$$u_{xx} + u_{yy} = (u_x)^2 + (u_y)^2$$

Solution:

$A = 1,$
$B = 0,$
$C = 1$
$B^2 - 4AC = 0 - 4(1)(1)$
$B^2 - 4Ac = -4$
$B^2 - 4Ac < 0$
$u_{xx} + u_{yy} = (u_x)^2 + (u_y)^2$ is Elliptic

12. Classify the following partial differential equations

$$y^2 u_{xx} - 2xyu_{xy} + x^2 u_{yy} + 2\, u_x - 3u = 0$$

Solution:

$A = y^2,$
$B = -2xy,$
$C = x^2$
$B^2 - 4Ac = 4x^2y^2 - 4(y^2)(x^2)$
$B^2 - 4Ac = 0$
$y^2u_{xx} - 2xyu_{xy} + x^2u_{yy} + 2\,u_x - 3u = 0$ is parabolic.

13. Classify the following partial differential equations

$$\boldsymbol{y^2u_{xx} + u_{yy} + u_x{}^2 + u_y{}^2 + 7 = 0}$$

Solution:

$A = y^2,$
$B = 0$
C= 1
$B^2 - 4Ac = 0 - 4(y^2)(1)$
$B^2 - 4Ac = -4(y^2)$
$B^2 - 4Ac < 0$
$y^2u_{xx} + u_{yy} + u_x{}^2 + u_y{}^2 + 7 = 0$ is elliptic.

14. The ends A and B of a rod of length 10 cm long have their temperature kept at20^oc and 70^oc Find the steady state temperature distribution on the rod.

Solution:

Steady state equation is u(x) = ax +b **(1)**

Put x=0, u=20

20=0 +b

b=20

Put x=10, u=70

70 =10a+ 20

10a=50

a=5

Substitute 'a' and 'b' values in (1) we get,

u(x)= 5x+20

15. Write the classification of second order quasi linear partial differential equation.

Solution:

Let a second order partial differential equation in the function u of the two independent variable x y be of the form.

$$A\frac{\partial^2 u}{\partial x^2} + B\frac{\partial^2 u}{\partial x \partial y} + C\frac{\partial^2 u}{\partial^2 y} + f\left(x, y, u, \frac{\partial u}{\partial x}, \frac{\partial u}{\partial y}\right) = 0 \qquad (1)$$

A, B, C …. may be constants also. Consider $\Delta = b^2 - 4ac$

Equation (1) is classified as elliptic, parabolic, or hyperbolic at the points of a given region R depending on whether

ELLIPTIC	PARABOLIC	HYPERBOLIC
$b^2 - 4ac < 0$	$b^2 - 4ac = 0$	$b^2 - 4ac > 0$
LAPLACE: $\frac{\partial^2 u}{\partial^2 x} + \frac{\partial^2 u}{\partial^2 y} = 0$	ONE DIMENSIONAL HEAT FLOW: $\frac{\partial^2 u}{\partial^2 x} + \frac{\partial^2 u}{\partial^2 y} = f(x,y)$	ONE DIMENSIONAL WAVE EQUATION: $\frac{\partial^2 u}{\partial t^2} = a^2 \frac{\partial^2 u}{\partial^2 x}$
POISSON	$\frac{\partial u}{\partial t} = \propto^2 \frac{\partial^2 u}{\partial^2 x}$	$a^2 = \frac{T}{M}$
	$\propto^2 = \frac{k}{c\rho}$	$a^2 = \frac{Tension}{Mass\ per\ unit\ length}$
	k = Thermal conductivity	
	c = Specific Heat	
	$\rho =$ Density	

16. Derive one dimensional wave equation.

Consider a tightly stretched elastic string of length l with its end points fixed. Let the string be released from rest and allowed to vibrate. The problem is to determine the deflection y(x,t) any point x and at any time t>0.

17. What are the possible solution for Laplace equation $\frac{\partial^2 u}{\partial^2 x} + \frac{\partial^2 u}{\partial^2 y} = 0$ by method of separation of variable.

Solution:

i) $u(x,y) = (c_1 e^{px} + c_1 e^{-px})(c_3 cospy + c_4 sinpy)$

ii) $u(x,y) = (c_1 cospx + c_2 sinpx)(c_3 e^{py} + c_{14} e^{-py})$

iii) $u(x,y) = (c_1 x + c_2)(c_3 t + c_4)$

18. In steady state conditions derive the solution of one dimensional heat flow equation.

Solution:

When steady state conditions exist the heat flow equation is independent of time t.

$\frac{\partial u}{\partial t} = 0$ The heat flow equation becomes $\frac{\partial^2 u}{\partial^2 x} = 0$

19. State Fourier law of heat conduction.

Solution:

The rate at which heat flow across an area A at a distance x from one end of a bar is given by Q=-

$KA\left(\frac{\partial u}{\partial t}\right)_x$ K is thermal conductivity and $\left(\frac{\partial u}{\partial t}\right)_x$ is the temperature gradient at x .

20. What is the basic difference between the solutions of one dimensional heat equation?

Solution:

Solution of the **one dimensional wave** equation is of **Periodic in Nature**.

But the solution of the **one dimensional Heat** Equation is **not of Periodic in Nature.**

UNIT IV

FOURIER TRANSFORM
PART – A

1. State Fourier integral theorem

If f(x) is piece-wise continuously differentiable and absolutely integrable in $(-\infty,\infty)$ then

$$f(x)=\frac{1}{\pi}\int_0^\infty\int_0^\infty f(t)\cos\lambda(t-x)\,dt\,d\lambda$$ This is known as **Fourier integral theorem.**

2. Define Fourier Transform pair.

The **complex (or finite) Fourier Transform** of f(x) is given by

$$F(s)=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx \quad \ldots\ldots\ldots (1)$$

Then the function f(x) is the **inverse Fourier Transform** of F(s) and is given by

$$f(x)=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} F(s)e^{-isx}\,ds \quad \ldots\ldots\ldots (2)$$

The above (1) & (2) are jointly called **Fourier transform pair.**

3. Prove that $F[f(ax)]=\frac{1}{|a|}F\left[\frac{s}{a}\right]$

WKT $F[f(x)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx$

$$F[f(ax)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(ax)e^{isx}\,dx$$

$$put \quad t=ax, \quad x\to-\infty\Rightarrow t\to-\infty,\ if \quad a>0$$

$$dt=a\,dx, \quad x\to\infty\Rightarrow t\to\infty,\ if \quad a>0$$

$$F[f(ax)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)e^{ist/a}\frac{dt}{a}$$

$$=\frac{1}{a}\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)e^{is\left(t/a\right)}\,dt \quad =\frac{1}{a}\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx/a}\,dx \qquad [t\ is\ dummy]$$

$$=\frac{1}{a}F\left[\frac{s}{a}\right]$$

4. If F (s) is the Fourier transform of f (x) show that $F[f(x-a)]=e^{ias}\ F(s)$

We know that $F[f(x)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx$

$$F[f(a-x)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x-a)e^{isx}\,dx$$

Put $t=x-a$ $\quad x\to-\infty \Rightarrow t\to-\infty$

$dt=dx$ $\quad x\to\infty \Rightarrow t\to\infty$

$$\therefore\ F[f(t)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)e^{is(t+a)}\,dt=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)e^{ist}e^{isa}\,dt$$

$$=e^{isa}\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(t)e^{ist}\,dt=e^{isa}F[f(t)]=e^{isa}F[s]$$

5. If F(s) is the Fourier transform of f(x), then $F[f(x)\cos ax]=\frac{1}{2}[F(s+a)+F(s-a)]$

We know that $F[f(x)]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx$

$$F[f(x)\cos ax]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)\cos ax\,e^{isx}\,dx$$

$$=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)\left[\frac{e^{iax}+e^{-iax}}{2}\right]e^{isx}\,dx$$

$$=\frac{1}{2}\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)\left[e^{i(s+a)x}+{}^{i(s-a)x}\right]dx$$

$$=\frac{1}{2}\left[\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{i(s+a)x}dx+\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{i(s-a)x}dx\right]$$

$$=\frac{1}{2}[F(s+a)+F(s-a)]$$

6. State Convolution Theorem for Fourier transforms.

If F(s) and G(s) are the Fourier transform of f(x) and g(x) respectively. Then the Fourier transform of the

convolution of f(x) and g(x) is the product of their Fourier transforms.

$(i.e)$ $F[f(x)*g(x)]=F(s)G(s)$ and $F^{-1}[F(s)G(s)]=f(x)*g(x)$

7. State Parseval's identity for Fourier transform.

If F(s) is the Fourier transform of f(x). Then $\int_{-\infty}^{\infty}|f(x)|^2\,dx=\int_{-\infty}^{\infty}|F(s)|^2\,ds$

8. Find the Fourier Transform of $f(x)=\begin{cases}1 & in \quad |x|<a \\ 0 & in \quad |x|>a\end{cases}$

The given function can be written as

$$f(x)=\begin{cases}1 & in \quad -a<x<a \\ 0 & in \quad -\infty<x<-a \;\; and \;\; a<x<\infty\end{cases}$$

We know that

$$F(s)=F\left[f(x)\right]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx \;=\frac{1}{\sqrt{2\pi}}\int_{-a}^{a}(1)\,e^{isx}\,dx$$

$$=\frac{1}{\sqrt{2\pi}}\left[\frac{e^{isx}}{is}\right]_{-a}^{a} \;=\frac{1}{\sqrt{2\pi}}\times\frac{1}{is}\left[e^{isa}-e^{-isa}\right]$$

We know that $e^{isa}-e^{-isa}=2i\sin sa$

$$\therefore \;\; F(s)=\frac{1}{\sqrt{2\pi}}\times\frac{1}{s}\left[2i\sin sa\right] \;=\sqrt{\frac{2}{\pi}}\left[\frac{\sin sa}{s}\right]$$

9. Write down the Fourier cosine transform pair of formulae.

The infinite **Fourier cosine transform** of f(x) is defined by

$$F_c\left[f(x)\right]=\sqrt{\frac{2}{\pi}}\int_0^{\infty} f(x)\cos sx\,dx$$

The **inverse Fourier cosine transform** $F_c\left[f(x)\right]$ is defined by

$$f(x)=\sqrt{\frac{2}{\pi}}\int_0^{\infty} F_c\left[f(x)\right]\cos sx\,ds$$

10. Write down the Fourier sine transform pair of formulae.

The infinite **Fourier sine transform** of f(x) is defined by

$$F_s\left[f(x)\right]=\sqrt{\frac{2}{\pi}}\int_0^{\infty} f(x)\sin sx\,dx$$

The **inverse Fourier sine transform** $F_s\left[f(x)\right]$ is defined by

$$f(x)=\sqrt{\frac{2}{\pi}}\int_0^{\infty} F_s\left[f(x)\right]\sin sx\,ds$$

11. Let $F_c(s)$ be the Fourier cosine transform of f(x) prove that

$$F_c\left[f(x)\cos ax\right]=\frac{1}{2}\left[F_c(s+a)+F_c(s-a)\right]$$

$$F_c\left[f(x)\cos ax\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\cos ax\cos sx\,dx$$

$$F_c\left[f(x)\cos ax\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\cos sx\cos ax\,dx$$

$$F_c\left[f(x)\cos ax\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\frac{1}{2}\left[\cos(s+a)x+\cos(s-a)x\right]dx$$

$$F_c\left[f(x)\cos ax\right]=\frac{1}{2}\left[\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\cos(s+a)x\,dx+\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\cos(s-a)x\,dx\right]$$

$$F_c\left[f(x)\cos ax\right]=\frac{1}{2}\left[F_c(s+a)+F_c(s-a)\right]$$

12. Find the Fourier cosine transform of e^{-ax} $a>0$

We know that $F_c\left[f(x)\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\cos sx\,dx$

$$F_c\left[e^{-ax}\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty e^{-ax}\cos sx\,dx$$

We know that $\int_0^\infty e^{-ax}\cos bx\,dx=\frac{a}{a^2+b^2}$

$$F_c\left[e^{-ax}\right]=\sqrt{\frac{2}{\pi}}\left[\frac{a}{s^2+a^2}\right]$$

13. Find the Fourier sine transform of e^{-ax} $a>0$

We know that $F_s\left[f(x)\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\sin sx\,dx$

$$F_s\left[e^{-ax}\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty e^{-ax}\sin sx\,dx$$

We know that $\int_0^\infty e^{-ax}\sin bx\,dx=\frac{b}{a^2+b^2}$

$$F_s\left[e^{-ax}\right]=\sqrt{\frac{2}{\pi}}\left[\frac{s}{s^2+a^2}\right]$$

14. Find the Fourier sine transform of $\frac{1}{x}$

We know that

$$F_s\left[f(x)\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty f(x)\sin sx\,dx$$

$$F_s\left[\frac{1}{x}\right]=\sqrt{\frac{2}{\pi}}\int_0^\infty \frac{1}{x}\sin sx\,dx$$

Let $sx=\theta$ $\quad x\to 0\Rightarrow\theta\to 0$

$$s\,dx = d\theta \quad x \to \infty \Rightarrow \theta \to \infty$$

$$= \sqrt{\frac{2}{\pi}} \int_0^\infty \left(\frac{s}{\theta}\right) \sin\theta \frac{d\theta}{s} \quad = \sqrt{\frac{2}{\pi}} \int_0^\infty \frac{\sin\theta}{\theta} d\theta$$

$$= \sqrt{\frac{2}{\pi}} \left[\frac{\pi}{2}\right] = \sqrt{\frac{\pi}{2}} \qquad \left[\because \frac{\sin\theta}{\theta} d\theta = \frac{\pi}{2}\right]$$

15. Find the Fourier cosine transform of e^{-x}

We know that $F_c[f(x)] = \sqrt{\frac{2}{\pi}} \int_0^\infty f(x) \cos sx\, dx$

$$F_c\left[e^{-x}\right] = \sqrt{\frac{2}{\pi}} \int_0^\infty e^{-x} \cos sx\, dx$$

We know that $\int_0^\infty e^{-ax} \cos bx\, dx = \frac{a}{a^2+b^2}$

$$F_c\left[e^{-x}\right] = \sqrt{\frac{2}{\pi}} \left[\frac{1}{s^2+1}\right]$$

16. Find the Fourier sine transform of e^{-x}

We know that $F_s[f(x)] = \sqrt{\frac{2}{\pi}} \int_0^\infty f(x) \sin sx\, dx$

$$F_s\left[e^{-x}\right] = \sqrt{\frac{2}{\pi}} \int_0^\infty e^{-x} \sin sx\, dx$$

We know that $\int_0^\infty e^{-ax} \sin bx\, dx = \frac{b}{a^2+b^2}$

$$F_s\left[e^{-x}\right] = \sqrt{\frac{2}{\pi}} \left[\frac{s}{s^2+1}\right]$$

17. Give a function which is self reciprocal under Fourier sine and cosine transforms.

$1/\sqrt{x}$

18. Find the Fourier sine transform of e^{-3x}

We know that $F_s[f(x)] = \sqrt{\frac{2}{\pi}} \int_0^\infty f(x) \sin sx\, dx$

$$F_s\left[e^{-3x}\right] = \sqrt{\frac{2}{\pi}} \int_0^\infty e^{-3x} \sin sx\, dx$$

We know that $\int_0^\infty e^{-ax} \sin bx\, dx = \frac{b}{a^2+b^2}$

$$F_s\left[e^{-3x}\right] = \sqrt{\frac{2}{\pi}} \left[\frac{s}{s^2+9}\right]$$

19. Find the Fourier Transform of $f(x)=\begin{cases}1 & in \quad |x|<1\\ 0 & in \quad |x|>1\end{cases}$

The given function can be written as

$$f(x)=\begin{cases}1 & in \quad -1<x<1\\ 0 & in \quad -\infty<x<1 \ and \ 1<x<\infty\end{cases}$$

We know that

$$F(s)=F\left[f(x)\right]=\frac{1}{\sqrt{2\pi}}\int_{-\infty}^{\infty} f(x)e^{isx}\,dx \quad =\frac{1}{\sqrt{2\pi}}\int_{-1}^{1}(1)\ e^{isx}\,dx$$

$$=\frac{1}{\sqrt{2\pi}}\left[\frac{e^{isx}}{is}\right]_{-1}^{1} \quad =\frac{1}{\sqrt{2\pi}}\times\frac{1}{is}\left[e^{is}-e^{-is}\right]$$

We know that $e^{is}-e^{-is}=2i\sin s$

$$\therefore \ F(s)=\frac{1}{\sqrt{2\pi}}\times\frac{1}{s}\left[2i\sin s\right] \quad =\sqrt{\frac{2}{\pi}}\left[\frac{\sin s}{s}\right]$$

20. Find the Fourier sine transform of $f(x)=1$ **in** $(0,l)$

WKT $F(s)=\int_0^l f(x)\,sin\left(\frac{n\pi x}{l}\right)dx$

Here $l=l$ & $f(x)=1$

$$\Rightarrow F(s)=\int_0^l (1)\,sin\left(\frac{n\pi x}{l}\right)dx=\int_0^l sin\left(\frac{n\pi x}{l}\right)dx$$

$$=\left[\frac{-\cos\left(\frac{n\pi x}{l}\right)}{\frac{n\pi}{l}}\right]_0^l=-\frac{l}{n\pi}\left[\cos\left(\frac{n\pi l}{l}\right)-\cos 0\right]$$

$$=-\frac{l}{n\pi}\left[(-1)^n-1\right] \quad =\frac{l}{n\pi}\left[1-(-1)^n\right]$$

21. State the Fourier transform of the derivatives under Fourier sine and cosine transforms.

(i) $F\left[x\,f(x)\right]=(-i)\frac{d}{ds}F(s)$

(ii) $F\left[x^n f(x)\right]=(-i)^n\frac{d^nF(s)}{ds^n}$

UNIT – V
Z-TRANSFORMS AND DIFFERENCE EQUATIONS
PART – A

1. Prove that Z [1] = $\frac{z}{z-1}$ $|z|>1$.

We know that Z{x (n)} = $\sum_{n=0}^{\infty} x(n)\, z^{-n}$

$$Z[1]=\sum_{n=0}^{\infty} z^{-n} = \sum_{n=0}^{\infty}\frac{1}{z} = \sum_{n=0}^{\infty}\left(\frac{1}{z}\right)^{n} = 1+\frac{1}{z}+\left(\frac{1}{z}\right)^{2}+.....$$

$$=\left[1-\frac{1}{z}\right]^{-1} = \left[\frac{z-1}{z}\right]^{-1}$$

$$Z[1]=\frac{z}{z-1},\ |z|>1$$

2. Prove that Z[a^n] = $\frac{z}{z-a}$ **if** $|z|>|a|$

We know that $Z\{x(n)\}=\sum_{n=0}^{\infty} x(n)z^{-n}$

$$z[a^n]=\sum_{n=0}^{\infty} a^n z^{-n} = \sum_{n=0}^{\infty} a^n \frac{1}{z^n} = \sum_{n=0}^{\infty} a^n\left(\frac{1}{z}\right)^{n} = \sum_{n=0}^{\infty}\left[\frac{a}{z}\right]^{n}$$

$$=1+\frac{a}{z}+\left(\frac{a}{z}\right)^{2}+.... = \left[1-\frac{a}{z}\right]^{-1} = \left[\frac{z-a}{z}\right]^{-1}$$

$$Z[a^n]=\frac{z}{z-a},\ |z|>|a|$$

3. Prove that $Z[n]=\frac{z}{(z-1)^2}, |z|>1$

We know that Z{x (n)} = $\sum_{n=0}^{\infty} x(n)\, z^{-n}$

$$Z[n]=\sum_{n=0}^{\infty} n\ z^{-n} = \sum_{n=0}^{\infty}\frac{n}{z^n} = \sum_{n=0}^{\infty} n\left(\frac{1}{z}\right)^{n} = 0+\frac{1}{z}+\left(\frac{1}{z}\right)^{2}+.....$$

$$=\frac{1}{z}\left[1+2\left(\frac{1}{z}\right)+3\left(\frac{1}{z}\right)^2+....\right]$$

$$=\frac{1}{z}\left[\left(1-\frac{1}{z}\right)^{-2}\right] \qquad \left[\begin{array}{l}\because\ (1-x)^{-2}=1+2x+3x^2+4x^3+....\\ Here \quad x=1/z\end{array}\right]$$

$$=\frac{1}{z}\left[\left(\frac{z-1}{z}\right)^{-2}\right] \ =\frac{1}{z}\left[\frac{z}{z-1}\right]^2=\frac{1}{z}\ \frac{z^2}{(z-1)^2}$$

$$Z(n)=\frac{z}{(z-1)^2},\ \ |z|>1$$

4. Prove that $Z\left(\frac{1}{n}\right)=\log\left(\frac{z}{z-1}\right)\ \ if\ |z|>1,\ n>0$.

We know that Z{x (n)} = $\sum_{n=0}^{\infty}x(n)\,z^{-n}$

$$Z\left[\frac{1}{n}\right]=\sum_{n=0}^{\infty}\frac{1}{n}\ z^{-n} \ =\sum_{n=0}^{\infty}\frac{1}{n\ z^n}=\sum_{n=0}^{\infty}\frac{1}{n}\left[\frac{1}{z}\right]^n$$

$$=\frac{1}{z}+\frac{1}{2}\left[\frac{1}{z}\right]^2+\frac{1}{3}\left[\frac{1}{z}\right]^3+..... \ =\frac{1}{z}+\frac{\left(\frac{1}{z}\right)^2}{2}+\frac{\left(\frac{1}{z}\right)^3}{3}+.....$$

$$=-\log\left[1-\frac{1}{z}\right]=-\log\left[\frac{z-1}{z}\right] \ =(-1)\log\left[\frac{z-1}{z}\right]=\log\left[\frac{z-1}{z}\right]^{-1}$$

$$Z\left(\frac{1}{n}\right)=\log\frac{z}{z-1}\ \ \left[\because\ \ \log a^p=p\log a\right],|z|>1$$

5. Prove that $z\left[\frac{1}{n+1}\right]=z\log\frac{z}{z-1}$

We know that $Z\left[x(n)\right]=\sum_{n=0}^{\infty}x(n)z^{-n}$

$$Z\left[\frac{1}{n+1}\right]=\sum_{n=0}^{\infty}\frac{1}{n+1}\ z^{-n}=\sum_{n=0}^{\infty}\frac{1}{n+1}\left(\frac{1}{z}\right)^n$$

$$=1+\frac{1}{2}\left(\frac{1}{z}\right)+\frac{1}{3}\left(\frac{1}{z}\right)^2+..... \qquad =z\left[\frac{1}{z}\right]\left[1+\frac{1}{2}\left(\frac{1}{z}\right)+\frac{1}{3}\left(\frac{1}{z}\right)^2+.....\right]$$

$$= z\left[\frac{1}{z}+\frac{\left(\frac{1}{z}\right)^2}{2}+\frac{\left(\frac{1}{z}\right)^3}{3}+.....\right]$$

$$= z\left[-\log\left(1-\frac{1}{z}\right)\right] \quad \left(\begin{array}{l}\because\ -\log(1-x)=x+\frac{1}{x^2}+\frac{1}{x^3}+....\\ Here\quad x=\frac{1}{z}\end{array}\right)$$

$$= z\left[-\log\left(\frac{z-1}{z}\right)\right]$$

$$Z\left[\frac{1}{n+1}\right]=z\left[\log\frac{z}{z-1}\right]=z\log\frac{z}{z-1}$$

6. **Prove that** $Z\left[\frac{1}{n!}\right]=e^{1/z}$

We know that $Z\left[x(n)\right]=\sum_{n=0}^{\infty}x(n)z^{-n}$

$$Z\left[\frac{1}{n!}\right]=\sum_{n=0}^{\infty}\frac{1}{n!}\ z^{-n}=\sum_{n=0}^{\infty}\frac{1}{n!}\left(\frac{1}{z}\right)^n=1+\frac{1}{1!}\left(\frac{1}{z}\right)+\frac{1}{2!}\left(\frac{1}{z}\right)^2+.....$$

$$=1+\frac{\left(\frac{1}{z}\right)}{1!}+\frac{\left(\frac{1}{z}\right)^2}{2!}+.....\quad =e^{1/z} \qquad \left[\begin{array}{l}\because\quad e^x=1+\frac{x}{1!}+\frac{x^2}{2!}+.....\\ Hear\quad x=\frac{1}{z}\end{array}\right]$$

7. **Find** $Z\left[\frac{1}{(n+1)!}\right]$

We know that $Z\left[x(n)\right]=\sum_{n=0}^{\infty}x(n)z^{-n}$

$$Z\left[\frac{1}{(n+1)!}\right]=\sum_{n=0}^{\infty}\frac{1}{(n+1)!}\ z^{-n}=\sum_{n=0}^{\infty}\frac{1}{(n+1)!}\left(\frac{1}{z}\right)^n \quad =\frac{1}{1!}\left[\frac{1}{z}\right]^0+\frac{1}{2!}\left[\frac{1}{z}\right]^1+\frac{1}{3!}\left[\frac{1}{z}\right]^2+.....$$

$$=1+\frac{[1/z]^2}{2!}+\frac{[1/z]^2}{3!}+.....\quad =z\left[\frac{(1/z)}{1!}+\frac{(1/z)^2}{2!}+.....\right]$$

$$= z\left[e^{1/z} - 1\right] \qquad \left[\begin{array}{l} \because e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \ldots \\ e^x - 1 = \frac{x}{1!} + \frac{x^2}{2!} + \ldots \end{array}\right] = ze^{1/z} - z$$

8. Find the Z-transform of (n + 2)

$$Z(n+2) = Z(n) + Z(2) \quad = Z(n) + 2Z(1) \quad = \frac{z}{(z-1)^2} + 2\frac{z}{z-1}$$

9. Find $Z\left[\cos\frac{n\pi}{2}\right]$ **and** $Z\left[\sin\frac{n\pi}{2}\right]$

We know that $Z\{\cos n\theta\} = \dfrac{z(z-\cos\theta)}{z^2 - 2z\cos\theta + 1}, \qquad |z| > 1$

$$Z\{\sin n\theta\} = \frac{z\sin\theta}{z^2 - 2z\cos\theta + 1}, \qquad |z| > 1$$

Put $\theta = \dfrac{\pi}{2}$

We know that $\cos 0 = 1$, $\cos\frac{\pi}{2} = 0$, $\sin 0 = 0$, $\sin\frac{\pi}{2} = 1$

$$Z\left[\cos\frac{n\pi}{2}\right] = \frac{z\left[z - \cos\frac{\pi}{2}\right]}{z^2 - 2z\cos\frac{\pi}{2} + 1} \quad = \frac{z[z-0]}{z^2 - 2z(0) + 1}$$

$$Z\left[\cos\frac{n\pi}{2}\right] = \frac{z^2}{z^2+1}, \qquad |z| > 1$$

and $$Z\left[\sin\frac{n\pi}{2}\right] = \frac{z\sin\frac{\pi}{2}}{z^2 - 2z\cos\frac{\pi}{2} + 1} \quad = \frac{z}{z^2 - 2z(0) + 1}$$

$$Z\left[\sin\frac{n\pi}{2}\right] = \frac{z}{z^2+1}$$

10. Find $Z[a^n n]$

We know that $Z[a^n f(n)] = F\left[\dfrac{z}{a}\right]$

$$Z[a^n n] = [Z[n]]_{z \to z/a}$$

$$=\left[\frac{z}{(z-1)^2}\right]_{z\to z/a} \qquad \left[\because \quad Z(n)=\frac{z}{(z-1)^2}\right]$$

$$=\frac{\frac{z}{a}}{\left(\frac{z}{a}-1\right)^2} \quad =\frac{\frac{z}{a}}{\left(\frac{z-a}{a}\right)^2} \quad =\frac{az}{(z-a)^2}$$

11. Find $Z\left[\frac{a^n}{n!}\right]$

We know that $Z[a^n f(n)]=F\left[\frac{z}{a}\right]$

$$Z\left[a^n\frac{1}{n!}\right]=\left[Z\left[\frac{1}{n!}\right]\right]_{z\to z/a} \quad =\left[e^{1/z}\right]_{z\to z/a} \quad =e^{\frac{1}{(z/a)}} \quad =e^{\frac{a}{z}}$$

12. Prove that $Z[nf(n)]=-z\frac{d}{dz}[f(z)]$

Given $F(z)=Z[f(n)]$

$$F(z)=\sum_{n=0}^{\infty} f(n)z^{-n}$$

$$\frac{d}{dz}[f(z)]=\sum_{n=0}^{\infty}(-n)f(n)z^{-n-1} \quad =-\sum_{n=0}^{\infty} nf(n)\frac{z^{-n}}{z}$$

$$z\frac{d}{dz}[f(z)]=-\sum_{n=0}^{\infty} nf(n)z^{-n} \quad =-Z[nf(n)]$$

$$Z[nf(n)]=-z\frac{d}{dz}[f(z)]$$

13. Find $Z(n^2)$

We know that $Z[nf(n)]=-z\frac{d}{dz}[f(z)]$

$$Z(n^2)=Z[n\times n]=-z\frac{d}{dz}[Z(n)] \quad =-z\frac{d}{dz}\left[\frac{z}{(z-1)^2}\right]$$

$$=-z\left[\frac{(z-1)^2(1)-z\left[2(z-1)\right]}{(z-1)^4}\right] \quad =-z\left[\frac{z-1-2z}{(z-1)^3}\right]=-z\left[\frac{-1-z}{(z-1)^3}\right]$$

$$=z\frac{(z+1)}{(z-1)^3}=\frac{z^2+z}{(z-1)^3}$$

14. Find the Z-transform of (n+1) (n+2).

$$Z\left[(n+1)(n+2)\right]=Z\left[n^2+2n+n+2\right] \quad =Z[n^2+3n+2] \quad =Z[n^2]+3z[n]+2Z[1]$$

$$=\frac{z^2+z}{(z-1)^3}+3\frac{z}{(z-1)^2}+2\frac{z}{z-1} \quad =\frac{(z^2+z)+3z(z-1)+2z(z-1)^2}{(z-1)^3}$$

$$=\frac{2z^3}{(z-1)^3} \quad =2\left[\frac{z}{z-1}\right]^3$$

15. State and prove Second Shifting theorem.

Proof:

Statement: $Z[f(n+1)]=zF(z)-zf(0)$

$$Z[f(n+1)]=\sum_{n=0}^{\infty} f(n+1)z^{-n} \quad =z\sum_{n=0}^{\infty} f(n+1)z^{-(n+1)}$$

$$=z\sum_{m=1}^{\infty} f(m)z^{-m} \qquad where \;\; m=n+1$$

$$=z\left[\sum_{m=0}^{\infty} f(m)z^{-m}-f(0)\right] \quad =zF(z)-zf(0)$$

16. State initial and final value theorem.

Initial value theorem:

If $Z[f(t)]=F(z)$, then $f(0)=\lim_{z\to\infty} F(z)$

Final value theorem:

If $Z[f(t)]=F(z)$, then $\lim_{t\to\infty} f(t)=\lim_{z\to 1} (z-1)F(z)$

17. Z-transform of unit step sequence i.e., $Z\{u(n)\}=\dfrac{z}{z-1}$

We know that $Z\{x(n)\}=\sum_{n=0}^{\infty} x(n)z^{-n}$

$$Z\{u(n)\}=\sum_{n=0}^{\infty} u(n)z^{-n} \quad =\sum_{n=0}^{\infty} z^{-n} \qquad by\, defn\, of\; u(n)$$

$$=1+\frac{1}{z}+\frac{1}{z^2}+.... \quad =\left[1-\frac{1}{z}\right]^{-1} \quad =\left[\frac{z-1}{z}\right]^{-1} \quad =\frac{z}{z-1}$$

18. State convolution theorem on Z – transform.

(i) If $Z[x(n)] = X(z)$ and $Z[y(n)] = Y(z)$ then $Z\{x(n) * y(n)\} = X(z).Y(z)$

(ii) If $Z[f(t)] = F(z)$ and $Z[g(t)] = G(z)$ then $Z\{f(t) * g(t)\} = F(z).G(z)$

19. State convolution theorem on inverse Z – transform.

$$Z^{-1}[F(z)G(z)] = f(n) * g(n) = Z^{-1}[F(z)] * z^{-1}[G(z)]$$

20. Derive the difference equation from $y_n = (A + Bn)2^n$

Given $y_n = (A + Bn)2^n$

$$y_n = A2^n + nB2^n$$

$$y_{n+1} = A2^{n+1} + B(n+1)2^{n+1}$$

$$= 2A2^n + 2B(n+1)2^n$$

$$y_{n+2} = A2^{n+2} + B(n+2)2^{n+2}$$

$$= 4A2^n + 4B(n+2)2^n$$

Eliminating A and B we get

$$\begin{vmatrix} y_n & 1 & n \\ y_{n+1} & 1 & 2(n+1) \\ y_{n+2} & 4 & 4(n+2) \end{vmatrix} = 0$$

$$y_n\left[8(n+2) - 8(n+1)\right] - 1\left[4(n+2)y_{n+1} - 2(n+1)y_{n+2}\right] + n\left[4y_{n+1} - 2y_{n+2}\right] = 0$$

$$y_n\left[8n + 16 - 8n - 8\right] - 1\left[(4n+8)y_{n+1} - (2n+2)y_{n+2}\right] + 4ny_{n+1} - 2ny_{n+2} = 0$$

$$y_n[8] - (4n+8)y_{n+1} + (2n+2)y_{n+2} + 4ny_{n+1} - 2ny_{n+2} = 0$$

$$y_{n+2}\left[-2n + 2n + 2\right] + y_{n+1}\left[-4n - 8 + 4n\right] + 8y_n = 0$$

$$2y_{n+2} - 8y_{n+1} + 8y_n = 0$$

$$y_{n+2} - 4y_{n+1} + 4y_n = 0$$

Unit – 1 – Partial Differential Equations

PART - B

1. Form PDE by Eliminating the arbitrary constants from the following $z=ax^3+by^3$. (3.7) [Ans :$px+qy=3z$]
2. Obtain the PDE of all spheres whose centre lies on the plane z=0 and whose radius is constants and equal to r.(3.12)

[Hits:The equation of the sphere is $(x-a)^2+(y-b)^2+z^2=r^2$] [Ans:$z^2(p^2+q^2+1)=r^2$]

3. Form a PDE by elimination the arbitrary function f and g in $z=x^2f(y)+y^2g(x)$ (3.36)
[Ans: $xyr=2(px+qy-2z)$]

4.Form a PDE by eliminating the arbitrary function from the following $f(x+y+z;\ x+y^2+z^2)=0$
[Ans:$(z-y)p+(x-z)q=y-x$]

5. Find the complete integral for $\sqrt{p}+\sqrt{q}=1$. (3.52) [Ans: $z=(1-\sqrt{b})^2x+by+c$]

6. Solve $z=px+qy+\sqrt{1+p2+q2}$ (3.64) [Ans:$z^2=1-x^2-y^2$]

7. Solve $p(1+q)=qz$ (3.76) [Ans:$\log(z-\frac{1}{a})=x+ay+b$]

8. Solve $pq+qx=y$ (3.93) [Hits:Divide by q] [Ans:$2az=2a^2x-ax^2+y^2+b$]

9. Solve $2x^4p^2-yzq-3z^2=0$ [Hits:$2(x^2p)^2-yqz-3z^2=0$put x=X;logy=Y] [Ans:$\log z=\frac{a\pm\sqrt{a2+24}}{2}(\frac{1}{x}+a\log y+y)$]

10. Solve $(2D^2+5DD'+2D'^2)z=0$(3.131)

11. $(D^3-7DD'^2+7D'^3)z=0$ (3.163) [Ans:$z=f_1(y+x)+f_2(y+2x)+f_3(y-3x)$]

12. $(D^2-D'^2)z=e^{x+2y}+7$ (3.165) [Ans:$z=f_1(y+x)+f_2(y-x)-\frac{1}{3}e^{x+2y}+\frac{7x2}{2}$]

13.$(D^2-DD')z=\sin x\cos 2y$ (3.165) Ans:$z=f_1(y)+f_2(y+x)+\frac{1}{2}\sin(x+2y)-\frac{1}{6}\sin(x-2y)$]

14. $(D^2+2DD'+D'^2)z=x^2+xy-y^2$. (3.164) [Ans:$z=f_1(y-x)+xf_2(y-x)+\frac{5}{6}x^3y-\frac{x4}{4}-\frac{x2y2}{2}$]

15. $(D^2+3DD'=2D'^2)z=12xy$. (3.166) [Ans:$z=f_1(y-x)+f_2(y-2x)+2x^3y-\frac{3}{2}x^4$]

Unit – 2 – FOURIER SERIES

PART – B

1. Express $f(x)=(\pi-x)^2$ as a Fourier series of period 2π in the interval $0<x<2\pi$. Hence deduced the sum of the series $1+\frac{1}{2^2}+\frac{1}{3^2}+\ldots$

2. Expand $f(x)=\begin{cases}\sin x, & 0\le x\le\pi\\ 0, & \pi\le x\le 2\pi\end{cases}$ as a Fourier series of periodicity 2π and hence evaluate $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+\ldots.$

3. Obtain the Fourier series for $f(x)=x+x^2$ in $(-\pi,\pi)$ hence deduce $\sum_{n=1}^{\infty}\frac{1}{n^2}=\frac{\pi^2}{6}$

4. Find the Fourier series for f (x) defined by $f(x)=\begin{cases}\sin x, & -\pi\le x\le 0\\ 0, & 0\le x\le\pi\end{cases}$ hence deduce the values of $\frac{1}{1.3}+\frac{1}{3.5}+\frac{1}{5.7}+\ldots.$

5. If $f(x)=\frac{1}{2}(\pi-x)$ find the fourier series of period 2π in the interval $(0,2\pi)$ hence deduce that $1-\frac{1}{3}+\frac{1}{5}-\ldots=\frac{\pi}{4}$

6. Find the Fourier series for $f(x)=|x|$ in $(-\pi,\pi)$ and deduce that $1+\frac{1}{3^2}+\frac{1}{5^2}+...=\frac{\pi^2}{8}$

7. Find the Fourier series for the function $f(x)=x^2, -\pi<x<\pi$ hence show that

$$(i)\ \frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+....=\frac{\pi^2}{6}$$

$$(ii)\ \frac{1}{1^2}-\frac{1}{2^2}+\frac{1}{3^2}+....=\frac{\pi^2}{12}$$

$$(iii)\ \frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+....=\frac{\pi^2}{8}$$

8. Expand $f(x)=|\cos x|$ in a fourier series in the interval $(-\pi,\pi)$

9. If $f(x)=\begin{cases}1+\frac{2x}{\pi}, & -\pi\le x\le 0\\ 1-\frac{2x}{\pi}, & 0\le x\le\pi\end{cases}$ show that $f(x)=\frac{8}{\pi^2}\left[\cos x+\frac{1}{3^2}\cos 3x+\frac{1}{5^2}\cos 5x+....\right]$

hence show that $\sum_{n=1}^{\infty}(2n-1)^{-2}=\frac{\pi^2}{8}$

10. Obtain the sine series for the function $f(x)=\begin{cases}x & 0\le x\le l/2\\ l-x & l/2\le x\le l\end{cases}$

11. Obtain the sine series for $f(x)=\begin{cases}x & 0\le x\le \frac{l}{2}\\ l-x & \frac{l}{2}\le x\le l\end{cases}$

12. Expand $f(x)=x(2\pi-x)$ as Fourier series in $(0,2\pi)$ and hence deduce that the sum of $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+...$

13. Obtain the Fourier series for the function f(x) given by $f(x)=\begin{cases}1-x & -\pi<x<0\\ 1+x & 0<x<\pi\end{cases}$ Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+...=\frac{\pi^2}{8}$.

14. Find the Fourier series up to second harmonic for $y=f(x)$ from the following values.

x	0	$\pi/2$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
y	1.0	1.4	1.9	1.7	1.5	1.2	1

15. The values of x and the corresponding values of f(x) over a period T are given below, Show that $f(x)=0.75x+0.37\cos\theta+1.004\sin\theta$ Where $\theta=\frac{2\pi x}{T}$

x	0	$T/6$	$T/3$	$T/2$	$2T/3$	$5T/6$	T
f(x)	1.98	1.30	1.05	1.30	-0.88	-0.25	1.98

16.Find the Fourier series of $f(x)=x^2\ in\ -\pi<x<\pi$. Hence show that $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+...\frac{\pi^4}{90}$.

UNIT – III - APPLICATIONS OF PARTIAL DIFFERENTIAL EQUATION

PART –B

1. A string is stretched and fastened to two points x=0 and x=l apart. Motion is stretched by displacing the string into the form $y = k(lx - x^2)$ from which it is released at time t=0. Find the displacement of any point on the string at a distance of x from one end at time t. (4.19 SINGARAVELU)

2. A tightly stretched string of length l has its ends fastened at x=0 and x=l. The midpoint of the string is then taken to a height h and then released from rest in that position. Obtain an expression for the displacement of the string at any subsequent time. (4.28 BALAJI,4.24 SINGARAVELU)

3. A string of length l is initially at rest in it is equilibrium position and motion is started by giving each of its points a velocity given by V=$\begin{cases} cx & if\ 0 \le x \le \frac{l}{2} \\ c(l-x) & if\ \frac{l}{2} \le x \le l \end{cases}$ Find the displacement function y(x ,t).(4.54 BALAJI)

4. If a string of length l is initially at rest in it is equilibrium position and each of its points is given by the velocity $v_0 sin^3 \frac{\pi x}{l}$, 0<x<l, determine the displacement of a point distant x from one end at time't'. (4.53 BALAJI)

5. Solve the problem of the vibrating string for the following boundary condition.

i) $u(0,t) = 0 for\ all\ t \ge 0$

ii) $u(l,t) = 0\ for\ all\ t \ge 0$

iii) $\frac{\partial u}{\partial t}(x,o) = 0$

$iv)$ $u(x,0) = \begin{cases} x & if\ 0 \le x \le \frac{l}{2} \\ (l-x) & if\ \frac{l}{2} \le x \le l \end{cases}$

6. A rod of length l with insulated sides is initially at a uniform temperature $u_{0.}$ It is ends are kept at $0^o c$ and kept so. Find the temperature distribution. (4.77 BALAJI)

7. A rod of length l has its ends A and B kept $0^o c$ and$150^o C$ respectively, until steady state conditions prevails, If the temperature at B is reduced to $0^o c$ and kept so, while that of A is maintained so, Find the temperature u(x ,t) at a distance x from A and at time t.

8. The ends A and B of a rod 30cm long have the temperature at $20^o c$ and $80^o c$ until steady state prevail. The temperature at the end B is then suddenly reduced to $60^o c$ and that of A is raised to$40^o c$ and maintained so. Find the temperature distribution. (4.101)

9. A square plate is bounded by the lines x=0, y=0, x=20, y=20. It is faces are insulated. The Temperature along the upper horizontal edges is given by u(x, 20) =x (20-x). When 0<x<20. While the other three edges are kept at $0^o c^{\cdot}$ Find the steasy state temperature in the plate. (4.110 SINGARAVELU)

10. A rectangular plate is bounded by the lines x=0, y=0, x=a, y=b. Its surfaces are insulated. The temperature along x=0, y=0 are kept at $0^O c$ and others at $100^o C^{\cdot}$ Find the steady state temperature at any point of the plate. (4.133 SINGARAVELU)

11. A rectangular plate with insulated surface is 10cm wide and so long compared to its width that it may be considered infinite length. If the temperature at short edge y=0 is given by

$u(x,0) = \begin{cases} 20x & for\ 0 \le x \le 5 \\ 20(10-x) & 5 \le x \le 10 \end{cases}$ and all the other three edges are kept at 0^oc. Find the steadystate temperature at any point of the plate.(4.157 SINGARAVELU)

12. An infinitely long rectangular plate with insulated surface is 10cm wide. The two edges and one edge are kept at zero temperature, while the other short edge x=0 is kept at temperature given by $u = \begin{cases} 20y & for\ 0 \le y \le 5 \\ 20(10-y) & 5 \le y \le 10 \end{cases}$

Find the steady state temperature in the plate.(4.163 SINGARAVELU, BALAJI)

13. The ends A and B of a rod 20cm long have the temperature at $30^o c$ and $80^o c$ until steady state prevail. The temperature of the ends are changed to $40^o c$ and $60^o \boldsymbol{C}$ respectively. Find the temperature distribution in the rod at time t.

14. A tightly stretched with fixed end points x=0 and x=l is initially in a position given by

$y(x,0) = y_0 sin^3 \frac{\pi x}{l}$. If it is released from rest from this position. Find the displacement y at any distance x from one end at any time t.(4.22 SINGARAVELU)

15. A tightly stretched with fixed end points x=0, x=l is initially at rest in its equilibrium position. If it is vibrating given each point a velocity $\lambda x(l-x)$ then show that

$u(x,t) = \frac{8\,\lambda l^3}{a\pi^4} \sum_{n=1,3,5}^{\infty} \frac{1}{n^4} sin \frac{n\pi x}{l} sin \frac{n\pi a t}{l}$(4.43 SINGARAVELU)

UNIT – 4 – FOURIER TRANSFORM

PART – B

1. Show that the Fourier Transform of f (x) = $e^{\frac{-x^2}{2}}$ is $e^{\frac{-s^2}{2}}$ (or) Show that $e^{\frac{-x^2}{2}}$ is self-reciprocal with respect to Fourier Transform. (Page: 2.25 - Singaravelu)

2. Find the Fourier Transform of $f(x) = \begin{cases} 1 & in\ |x| < a \\ 0 & in\ |x| > a \end{cases}$

3. Find the Fourier Transform of $f(x) = \begin{cases} a - |x| & for\ |x| < a \\ 0 & for\ |x| > a > 0 \end{cases}$ hence deduce that

$$\int_0^\infty \left(\frac{\sin t}{t}\right)^2 dt = \frac{\pi}{2}$$

4. Find Fourier Transform of $e^{-a|x|}$ and hence deduce that

(i) $F\left[x e^{-a|x|}\right] = i\sqrt{\frac{2}{\pi}} \frac{2as}{(s^2+a^2)^2}$

(ii) $\int_0^\infty \frac{\cos xt}{a^2+t^2} dt = \frac{\pi}{2a} e^{-a|x|}$

5. Find the Fourier transform of the function f(x) defined by $f(x) = \begin{cases} 1-x^2 & if\ |x| < 1 \\ 0 & if\ |x| \ge 1 \end{cases}$ Hence

prove that

$\int_0^\infty \frac{\sin s - s\cos s}{s^3}\cos\left(\frac{s}{2}\right)ds = \frac{3\pi}{16}$. Also show that $\int_0^\infty \frac{(x\cos x - \sin x)^2}{x^6}dx = \frac{\pi}{15}$

6. Show that the Fourier transform of $f(x) = \begin{cases} a^2 - x^2 & |x| < a \\ 0 & |x| > a > 0 \end{cases}$ is $2\sqrt{\frac{2}{\pi}}\left[\frac{\sin as - as\cos as}{s^3}\right]$ hence deduce that

$\int_0^\infty \frac{\sin t - t\cos t}{t^3}dt = \frac{\pi}{4}$. Using Parseval's identity shows that $\int_0^\infty \left[\frac{\sin t - t\cos t}{t^3}\right]^2 dt = \frac{\pi}{15}$.

7. Find the Fourier Transform of $e^{-a|x|}$, $a > 0$ Deduce that (i) $\int_0^\infty \frac{\cos xt}{a^2 + t^2}dt = \frac{\pi}{2a}e^{-a|x|}$ (ii)

$F\left[xe^{-a|x|}\right] = i\sqrt{\frac{2}{\pi}}\frac{2as}{(s^2 + a^2)^2}$

8. Find the Fourier transform of $f(x) = \begin{cases} 1 & for\,|x| < a \\ 0 & for\,|x| > a \end{cases}$ and deduce (i) $\int_0^\infty \frac{\sin t}{t}dt$ (ii)

$\int_0^\infty \left(\frac{\sin x}{x}\right)^2 dx$ (iii) $\int_0^\infty \frac{\sin as}{s}\cos sx\,ds = \frac{\pi}{4}$ $when\ |x| = a$

9. Find the Fourier transform of $f(x) = \begin{cases} 1 & for\,|x| < a \\ 0 & otherwise \end{cases}$ hence prove that

$\int_0^\infty \frac{\sin x}{x}dx = \int_0^\infty \frac{\sin^2 x}{x^2}dx = \frac{\pi}{2}$

10. Find the Fourier transform of $f(x)$ given by $f(x) = \begin{cases} 1 & for\ |x| < 2 \\ 0 & for\ |x| > 2 \end{cases}$ and hence evaluate

$\int_0^\infty \frac{\sin x}{x}dx$ and $\int_0^\infty \left[\frac{\sin x}{x}\right]^2 dx$

11. Evaluate $\int_0^\infty \frac{dx}{(x^2 + a^2)(x^2 + b^2)}$ using Fourier transform.

12. Find the F.C.T of e^{-ax} hence deduce the value of $\int_0^\infty \frac{dx}{(x^2 + 1)(x^2 + 4)}$

13. Using Fourier sine transform prove that $\int_0^\infty \frac{\lambda^2 d\lambda}{(a^2 + \lambda^2)(s^2 + \lambda^2)} = \frac{\pi}{2(a + b)}$

14. Using Parseval's identity, evaluate $\int_0^\infty \frac{x^2 dx}{(x^2 + a^2)^2}$ where a>0

15. Using Parseval's identity, evaluate $\int_0^\infty \frac{dx}{(x^2 + a^2)^2}$, $a > 0$

16. Find the Fourier sine Transform of $f(x) = \begin{cases} x & in\ 0 < x < 1 \\ 2 - x & in\ 1 < x < 2. \\ 0 & in\ x > 2 \end{cases}$

Unit – 5 – Z-TRANSFORMS

PART – B

1. Find $Z\left[\frac{1}{(n+1)(n+2)}\right]$ 2. Find $Z^{-1}\left[\frac{10z}{(z-1)(z-2)}\right]$ 3. Find $Z^{-1}\left[\frac{z(z^2-z+2)}{(z+1)(z-1)^2}\right]$

4. Find $Z^{-1}\left[\frac{z^2}{(z+2)(z^2+4)}\right]$ 5. Find $Z^{-1}\left[\frac{z^3}{(z-1)^2(z-2)}\right]$ using partial fraction.

6. Find $Z^{-1}\left[\frac{z(z+1)}{(z-1)^3}\right]$ 7. Find $Z^{-1}\left[\frac{1}{\left(z-\frac{1}{2}\right)\left(z-\frac{1}{3}\right)}\right]$ 8. Find $Z^{-1}\left[\frac{8z^2}{(2z-1)(4z+1)}\right]$

9. Find $Z^{-1}\left[\frac{z^2}{(z-a)^2}\right]$ 10. Find $Z^{-1}\left[\frac{z^2}{(z-a)(z-b)}\right]$

11. Using convolution theorem evaluate inverse Z- transform of $\left[\frac{z^2}{(z-1)(z-3)}\right]$

12. Find $Z^{-1}\left[\frac{z^2}{\left(z-\frac{1}{2}\right)\left(z+\frac{1}{4}\right)}\right]$ 13. Find $Z^{-1}\left[\frac{z^2}{(z+a)^2}\right]$

14. From $y_n = a2^n + b(-2)^n$, derive a difference equation by eliminating the constants.

15. From the difference equation from $y_n = a + b3^n$

16. Solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ with $y_0 = y_1 = 0$ using Z –transforms.

17. Solve $y(k+2) - 4y(k+1) + 4y(k) = 0$ with $y(0) = 1, y(1) = 0$ using Z –transforms.

18. Solve $u_{n+2} - 5u_{n+1} + 6u_n = 4^n$ with $u_0 = 0,\ u_1 = 1$ using Z –transforms.

B.E/B.Tech DEGREE EXAMINATION, MAY/JUNE 2009

Third Semester

(Regulations 2008)

MA 1201-MATHEMATICS III

(Common to All branches of B.E./B.Tech EXCEPT Bio-Medical Engineering)

Time : Three hours **Maximum : 100 marks**

Answer ALL questions.

PARTA-(10 x2=20 marks

1. Expand f(x) = 1 in a sine series in 0< x < π.

2. State Parseval's identity for the half-range cosine expansion of f(x) in (0,1).

3. If Fourier Transform of f(x) = F(s) then what is Fourier Transform of f(ax).

4. If F(s) is the Fourier Transform of f(x) , then show that the Fourier transform of $e^{iax}\ f(x)$ is F(s+a).

5. Eliminate the arbitrary constants a and b from z = ax + by + a^2 + b^2.

6. Solve : $(D^2 - 4DD' + 3D'^2)z = 0$.

7. Write the boundary conditions and initial conditions for solving the vibration of string equation, if the string is subjected to initial displacement f(x) and initial velocity g(x).

8. The ends A and B of a rod of length 10cm long have their temperature kept at 20℃ and 70℃ . Find the steady state temperature distribution on the rod.

9. State Final value theorem.

10. State Convolution theorem.

Answer all Questions

PART-B (5 X16 = 80)

11.(a)What is the Fourier expansion of the periodic function whose definition is one period is

f(x) =$\begin{cases} 0 & -\pi \le x \le 0 \\ sinx & 0 \le x \le \pi \end{cases}$? Hence evaluate : (i)$\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \frac{1}{7.9} + \ldots$

(ii) $\frac{1}{1.3} + \frac{1}{3.5} + \frac{1}{5.7} + \frac{1}{7.9} + \ldots$

(OR)

(b) i).Obtain the sine series for the function f(x) =$\begin{cases} x, & 0 \le x \le l/2 \\ l-x, & l/2 \le x \le l \end{cases}$

ii).Find the half-range cosine series for the function f(x) = x($\pi - x$) in 0< x < π. Deduce that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \cdots = \frac{\pi^4}{90}$

12.(a).i)Show that the Fourier Transform of $e^{\frac{-x^2}{2}}$ is $e^{\frac{-s^2}{2}}$

ii)Evaluate $\int_0^\infty \frac{dx}{(x^2+a^2)(x^2+b^2)}$ using transforms.

(OR)

(b)Find the Fourier transform of the function f(x) defined by f(x) =$\begin{cases} 1-x^2 & if\ |x| < 1 \\ 0 & if\ |x| \ge 1 \end{cases}$ Hence prove that $\int_0^\infty \frac{\sin s - s\cos s}{s^3} \cos\left(\frac{s}{2}\right) ds = \frac{3\pi}{16}$.

13.(a) (i). Find the general solution of $x(y^2 - z^2)p + y(z^2 - x^2)q = z(x^2 - y^2)$

(ii).Obtain the general solution of p zx + q zy = xy.

(OR)

(b)i)Solve $(D^2 + 2DD' + D'^2)\, z = x^2y + e^{x-y}$

ii)Solve $z = px + qy + (pq)^{3/2}$.

14.(a) A string of length 2l is fastend at both ends. The midpoint of the string is taken to a height b and then released from rest in that position. Show that the displacement is

$$Y(x,t) = \frac{8b}{\pi^2} \sum_{n=1}^{\infty} \frac{(-1)^{n-1}}{(2n-1)^2} \sin\left(\frac{(2n-1)\pi x}{2l}\right) \cos\left(\frac{(2n-1)\pi at}{2l}\right)$$

(b).If a string of length l is initially at rest in its equilibrium position and each of its points is given the velocity $\frac{v_0 \sin^3 \pi x}{l}$, 0 < x < l, determine the displacement of a point distant x from one end at time 't'.

15. (a). Using Z transform , solve the difference equation $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ given that $y_0 = y_1 = 0$.

(OR)

(b)Using Z-transform, solve $y_{n+2} + 4y_{n+1} - 5y_n = 24n - 8$ given that $y_0 = 3$ and $y_1 = -5$.

B.E/B.Tech DEGREE EXAMINATION, MAY/JUNE 2011

Third Semester

(Regulations 2010)

181301 - Transforms and Partial Differential Equations

(Common to All branches of B.E./B.Tech EXCEPT Bio-Medical Engineering)

Time : Three hours **Maximum : 100 marks**

Answer ALL questions.

PARTA-(10 x2=20 marks

1. State the sufficient conditions for a function f(x) to be expressed as a Fourier Series`.
2. Obtain the first term of the Fourier Series for the function f(x)=x^2 ,-π <x < π.
3. Find the Fourier transform of $f(x) = \begin{cases} e^{ikx}, a < x < b \\ 0, x \leq a \text{ and } x > b \end{cases}$
4. Find the Fourier Sine transform of $\frac{1}{x}$.
5. Find the partial differential equation of all planes cutting equal intercepts from the x and y axes.
6. Solve (D^3 -2 D^2D^1)Z = 0.
7. Classify the partial differential equation 4 $\frac{\partial^2 u}{\partial x^2} = \frac{\partial u}{\partial t}$.
8. Write down all the possible solutions of one dimensional wave equation.
9. If F (z)=$\frac{z^2}{\left(z-\frac{1}{2}\right)\left(z-\frac{1}{4}\right)\left(z-\frac{3}{4}\right)}$,find f(0) by initial value theorem.
10. Find the Z-transform of$\frac{a^n}{n!}$.

PART B(5 x 16 =80)

11. a. (i). Obtain the Fourier Series of f(x)=x + x^2 in (-π, π).

(b) Obtain the sine series for the function

$$f(x)=\begin{cases} x \quad in \quad 0 \leq x \leq \frac{l}{2} \\ l - x \ in \ \frac{l}{2} \leq x \leq l \end{cases}.$$

OR

b. (i)Find the half range cosine series of f(x)=x in (0,π) and hence prove that

$1 + \frac{1}{3^4} + \frac{1}{5^4} + \ldots = \frac{\pi^4}{96}$.

(ii). Obtain a Fourier series up to the harmonic from

X	0	$\frac{\pi}{6}$	$\frac{2\pi}{6}$	$\frac{3\pi}{6}$	$\frac{4\pi}{6}$	$\frac{5\pi}{6}$	π
Y	2.34	2.2	1.6	0.83	0.51	0.88	1.19

12. a. (i). Find the Fourier Transform of f(x) if F(x)=$\begin{cases} 1-x^2, & 1x1 < 1 \\ 0, & 1x1 > 1 \end{cases}$

Hence deduce $\int_0^\infty \left(\frac{\sin t}{t}\right) dt$

(ii).Show that the Fourier Transform of $e^{-\frac{x^2}{2}}$ is $e^{-\frac{s^2}{2}}$.

OR

b. (i). Find the Fourier Sine Transform of f(x)=$\begin{cases} \sin x, & 0 \le x < a \\ 0, & x > a \end{cases}$

(ii). Using Fourier Cosine Transform method, evaluate xe^{-2x},x>0.

13. a.(i). Solve $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$.

(ii). Solve p(1+q) = qz.

OR

b. (i). Solve $(D^3 - 2D^2D^1)Z = 2e^{2x} + 3x^2y$.

(ii). Find the singular solution of $z = px + qy + q^2 - p^2$.

14.(a). A tightly stretched string with fixed end points x=0 and x=l is initially in a position given by y(x, 0) = $k \sin\frac{3\pi x}{l} \cos\frac{2\pi x}{l}$. If it is released from rest from this position, determine the displacement y(x,t).

OR

(b).A bar 10 cm long , with insulated sides, has its ends A and B kept at 20°C and 40°C respectively until steady state conditions prevail. The temperature at A is then suddenly raised to 50°C and at the same instant that at B is lowered to 10 °C.Find the subsequent temperature at any point of the bar at any time.

15.a.(i). Find the inverse Z-transform of $\frac{z}{(z-1)^2(z+1)}$.

(ii).Find Z transform of f(n)=[$\frac{2n+3}{(n+1)(n+2)}$] .

OR

b.(i).Using convolution theorem, find the inverse of $\frac{z^2}{(z-2)(z-3)}$.

(ii). Solve Using z – transform $y_{n+2} - 4y_{n+1} + 3y_n = 0$ given y(0)=2 and y(1) = 4

Question Paper Code : 11485

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2012.

Third Semester

Civil Engineering

MA 2211/MA 31/MA 1201 A/CK 201/10177 MA 301/080100008/080210001/ M/ [illegible] 211 [illegible] TM [illegible] 9211 [illegible] TF [illegible] NS. OF [illegible] IS AN [illegible] PA TI [illegible] D. FF [illegible] EI TI/ [illegible] RO [illegible] A IO IS

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(Regulat[illegible] n 2008)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the co-efficient b_n of the Fourier series for the function $f(x) = x \sin x$ in $(-2, 2)$.

2. Define Root Mean Square value of a function $f(x)$ over the interval (a, b).

3. Find the Fourier transform of $e^{-\alpha|x|}$, $\alpha > 0$.

4. State convolution theorem in Fourier transform.

5. Eliminate the arbitrary function 'f' from $z = f\left(\frac{y}{x}\right)$ and form the PDE.

6. Solve : $(D-1)(D-D'+1)z = 0$.

7. An insulated rod of length 60 cm has its ends at A and B maintained at 20°C and 80°C respectively. Find the steady state solution of the rod.

8. A plate is bounded by the lines $x = 0$, $y = 0$, $x = l$ and $y = l$. Its faces are insulated. The edge coinciding with x-axis is kept at 100°C. The edge coinciding with y-axis is kept at 50°C. The other two edges are kept at 0°C. Write the boundary conditions that are needed for solving two dimensional heat flow equation.

9. Find the Z-transform of a^n.

10. Solve $y_{n+1} - 2y_n = 0$, given that $y(0) = 2$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the Fourier series expansion of $f(x) = x + x^2$ in $(-\pi, \pi)$. (8)

(ii) Find the Fourier series expansion of $f(x) = \begin{cases} x, & 0 \le x \le 1 \\ 2-x, & 1 \le x \le 2 \end{cases}$. Also deduce $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots \text{ to } \infty = \frac{\pi^2}{8}$. (8)

Or

(b) (i) Obtain the half range cosine series for $f(x) = x$ in $(0, \pi)$. (8)

(ii) Find the Fourier series as far as the second harmonic to represent the function $f(x)$ with period 6, given in the following table : (8)

x	0	1	2	3	4	5
$f(x)$	9	18	24	28	26	20

12. (a) (i) Find the Fourier transform of $f(x) = \begin{cases} 1-|x| & \text{if } |x| < 1 \\ 0 & \text{if } |x| > 1 \end{cases}$ and hence evaluate $\int_0^\infty \frac{\sin^4 t}{t^4}\, dt$. (8)

(ii) Find the Fourier transform of $f(x) = \begin{cases} a^2 - x^2, & |x| \le a \\ 0, & |x| > a > 0 \end{cases}$. Hence deduce that $\int_0^\infty \frac{\sin t - t\cos t}{t^3}\, dt = \frac{\pi}{4}$. (8)

Or

(b) (i) Find the Fourier cosine and sine transforms of $f(x) = e^{-ax}$, $a > 0$ and hence deduce the inversion formula. (8)

(ii) Find the Fourier cosine transform of $e^{-a^2x^2}$, $a > 0$. Hence show that the function $e^{-x^2/2}$ is self-reciprocal. (8)

13. (a) (i) Find the singular integral of $z = px + qy + p^2 + pq + q^2$. (8)

(ii) Solve the partial differential equation $(x - 2z)p + (2z - y)q = y - x$. (8)

Or

(b) (i) Solve : $(D^2 + 3DD' - 4D'^2)z = \cos(2x + y) + xy$. (8)

(ii) Solve : $(D^2 - DD' + 2D)z = e^{2x+y} + 4$. (8)

14. (a) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x, 0) = y_0 \sin^3\left(\frac{\pi x}{l}\right)$. It is released from rest from this position. Find the expression for the displacement at any time t. (16)

Or

(b) Find the steady state temperature distribution in a rectangular plate of sides a and b insulated at the lateral surfaces and satisfying the boundary conditions :
$u(0, y) = u(a, y) = 0$, for $0 \le y \le b$;
$u(x, b) = 0$ and $u(x, 0) = x(a - x)$, for $0 \le x \le a$. (16)

15. (a) (i) Find the Z-transforms of $\sin^2\left(\frac{n\pi}{4}\right)$ and $\cos\left(\frac{n\pi}{2} + \frac{n\pi}{4}\right)$. (8)

(ii) Using convolution theorem, find the inverse Z-transform of $\frac{z^2}{(z+a)^2}$. (8)

Or

(b) (i) Solve the difference equation using Z-transform $y_{(n+3)} - 3y_{(n+1)} + 2y_{(n)} = 0$ given that $y_0 = 4$, $y_1 = 0$, $y_2 = 8$. (8)

(ii) Solve $y_{(n+2)} + 6y_{(n+1)} + 9y_{(n)} = 2^n$ given that $y_0 = y_1 = 0$. (8)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 21522

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Third Semester

Civil Engineering

MA 2211/MA 31/MA 1201 A/CK 201/10177 MA 301/080100008/080210001 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches)

(Regulation 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the Dirichlet's conditions for Fourier series.

2. What is meant by Harmonic Analysis?

3. Find the Fourier Sine Transform of e^{-3x}.

4. If $\mathfrak{F}_t\{f(x)\} = F(s)$, prove that $\mathfrak{F}_t\{f(ax)\} = \frac{1}{a} \cdot F\left(\frac{s}{a}\right)$.

5. Form the PDE from $(x-a)^2 + (y-b)^2 + z^2 = r^2$.

6. Find the complete integral of $p + q = pq$.

7. In the one dimensional heat equation $u_t = c^2 \cdot u_{xx}$, what is c^2?

8. Write down the two dimensional heat equation both in transient and steady states.

9. Find $Z(n)$.

10. Obtain $Z^{-1}\left[\frac{z}{(z+1)(z+2)}\right]$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the Fourier series of x^2 in $(-\pi, \pi)$ and hence deduce that $\frac{1}{1^4} + \frac{1}{2^4} + \frac{1}{3^4} + \ldots \frac{\pi^4}{90}$. (8)

(ii) Obtain the Fourier cosine series of $f(x) = \begin{cases} kx, & 0 < x < l/2 \\ k(l-x), & l/2 < x < l \end{cases}$. (8)

Or

(b) (i) Find the complex form of Fourier series of $\cos ax$ in $(-\pi, \pi)$, where "a" is not an integer. (8)

(ii) Obtain the Fourier cosine series of $(x-1)^2$, $0<x<1$ and hence show that $\frac{1}{1^2}+\frac{1}{2^2}+\frac{1}{3^2}+\ldots=\frac{\pi^2}{6}$. (8)

12. (a) (i) Find the Fourier transform of $f(x)=\begin{cases}1, & |x|<a \\ 0, & |x|>a\end{cases}$ and hence find $\int_0^\infty \frac{\sin x}{x}dx$. (8)

(ii) Verify the convolution theorem under Fourier Transform, for $f(x)=g(x)=e^{-x^2}$. (8)

Or

(b) (i) Obtain the Fourier Transform of $e^{-x^2/2}$. (8)

(ii) Evaluate $\int_0^\infty \frac{dx}{(x^2+a^2)^2}$ using Parseval's identity. (8)

13. (a) (i) Solve : $x(y^2-z^2)p+y(z^2-x^2)q=z(x^2-y^2)$. (8)

(ii) Solve : $(D^2+DD'-6D'^2)z=y\cdot\cos x$. (8)

Or

(b) (i) Solve : $z=px+qy+\sqrt{p^2+q^2+1}$. (8)

(ii) Solve : $(D^3-7DD'^2-6D'^3)z=\sin(2x+y)$. (8)

14. (a) A tightly stretched string between the fixed end points $x=0$ and $x=l$ is initially at rest in its equilibrium position. If each of its points is given a velocity $kx(l-x)$, find the displacement $y(x,t)$ of the string.

Or

(b) An infinitely long rectangular plate is of width 10 cm. The temperature along the short edge $y=0$ is given by $u=\begin{cases}20x, & 0<x<5 \\ 20(10-x), & 5<x<10\end{cases}$. If all the other edges are kept at zero temperature, find the steady state temperature at any point on it.

15. (a) (i) Find $Z(\cos n\theta)$ and hence deduce $Z\left(\cos\frac{n\pi}{2}\right)$. (8)

(ii) Using Z-transform solve : $y_{n+2}-3y_{n+1}-10y_n=0$, $y_0=1$ and $y_1=0$. (8)

Or

(b) (i) State and prove the second shifting property of Z-transform. (6)

(ii) Using convolution theorem, find $Z^{-1}\left[\frac{z^2}{(z-a)(z-b)}\right]$. (10)

Reg. No. : [ ]

Question Paper Code : 31522

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Third Semester

Civil Engineering

MA 2211/MA 31/MA 1201 A/CK 201/10177 MA 301/080100008/080210001 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches)

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the value of a_0 in the Fourier series expansion of $f(x) = e^x$ in $(0, 2\pi)$.
2. Find the half range sine series expansion of $f(x) = 1$ in $(0, 2)$.
3. Define self reciprocal with respect to Fourier Transform.
4. Prove that $F[f(x-a)] = e^{ias}F[f(x)]$.
5. Form a PDE by eliminating the arbitrary constants 'a' and 'b' from $z = ax^2 + by^2$.
6. Solve $\frac{\partial^2 z}{\partial x^2} - \frac{\partial^2 z}{\partial x \partial y} + \frac{\partial z}{\partial x} = 0$.
7. Define steady state condition on heat flow.
8. An insulated rod of length l cm has its ends A and B maintained at 0°C and 80°C respectively. Find the steady state solution of the rod.
9. Find the Z-transform of $\frac{1}{n}$.
10. Find the inverse Z-transform of $\frac{z}{(z+1)^2}$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the Fourier Series Expansion of $f(x) = \begin{cases} 1 & for\ 0 < x < \pi \\ 2 & for\ \pi < x < 2\pi \end{cases}$. (8)

(ii) Find the Fourier series expansion of $f(x) = \begin{cases} -x+1, & -\pi < x < 0 \\ x+1, & 0 < x < \pi \end{cases}$. (8)

Or

(b) (i) Find the half range sine series of $f(x) = lx - x^2$ in $(0, l)$. (8)

(ii) Find the first two harmonics of the Fourier series expansion for the following data. (8)

x	0	$\pi/3$	$2\pi/3$	π	$4\pi/3$	$5\pi/3$	2π
y	1.0	1.4	1.9	1.7	1.5	1.2	1.0

12. (a) Find the Fourier transform of $f(x) = \begin{cases} 1 - x^2, & |x| \le 1 \\ 0, & |x| > 1 \end{cases}$

Hence show that

(i) $\int_0^\infty \frac{\sin s - s\cos s}{s^3} \cos\left(\frac{s}{2}\right) ds = \frac{3\pi}{16}$ and

(ii) $\int_0^\infty \frac{(x\cos x - \sin x)^2}{x^6} dx = \frac{\pi}{15}$. (16)

Or

(b) (i) Using Fourier Cosine Transform, evaluate $\int_0^\infty \frac{dx}{(x^2 + a^2)^2}$. (8)

(ii) Find the function whose Fourier Sine Transform is $\frac{e^{-as}}{s}$ $(a > 0)$. (8)

13. (a) (i) Form the PDE by eliminating the arbitrary function 'f' and 'g' from $z = x^2 f(y) + y^2 g(x)$. (8)

(ii) Solve $[D^2 - DD' - 2D'^2] z = 2x + 3y + e^{2x+4y}$. (8)

Or

(b) (i) Solve $(y^2 + z^2) p - xyq + xz = 0$. (8)

(ii) Find the singular integral of $z = px + qy + \sqrt{1 + p^2 + q^2}$. (8)

14. (a) A tightly stretched string with fixed end points $x = 0$ and $x = l$ is initially in a position given by $y(x, 0) = K(lx - x^2)$. It is released from rest from this position. Find the expression for the displacement at any time 't'. (16)

Or

(b) Find the solution to the equation $\frac{\partial u}{\partial t} = a^2 \frac{\partial^2 u}{\partial x^2}$ that satisfies the conditions $u(0, t) = 0$, $u(l, t) = 0$, for $t > 0$ and

$u(x, 0) = \begin{cases} x, & 0 \le x \le l/2 \\ l - x, & l/2 < x < l \end{cases}$ (16)

15. (a) (i) Find the Z-transform of $\frac{1}{(n+1)(n+2)}$. (8)

(ii) Using Z-transform solve the difference equation $Y_{n+2} + 2Y_{n+1} + Y_n = n$ given $Y_0 = 0 = Y_1$. (8)

Or

(b) (i) Form the difference equation from $Y(n) = (A + Bn) 2^n$. (8)

(ii) Using convolution theorem find $Z^{-1}\left[\frac{z^2}{(z-1)(z-3)}\right]$. (8)

Reg. No. : [ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ][ ]

Question Paper Code : 51571

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Third Semester

Civil Engineering

MA 2211/MA 31/MA 1201 A/CK 201/080100008/080210001/10177 MA 301 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS/ MATHEMATICS — III

(Common to all branches)

(Regulation 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State the conditions for a function $f(x)$ to be expanded as a Fourier series in a given interval.

2. Expand $f(x) = 1$ as a half range sine series in the interval $(0, \pi)$.

3. Find the Fourier sine transform of $f(x) = \frac{1}{x}$.

4. State the Fourier integral theorem.

5. Form the PDE by eliminating the arbitrary constants a, b from the relation $z = ax^3 + by^3$.

6. Solve : $(D^4 - D'^4)z = 0$.

7. Write all the solutions of the one-dimensional wave equation $y_{tt} = \alpha^2 y_{xx}$.

8. State the assumptions in deriving the one-dimensions heat flow equation (unsteady state).

9. Find the Z-transform of n^2.

10. State the convolution theorem on Z-transforms.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Expand $f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi < x < 0 \\ 1 - \frac{2x}{\pi}, & 0 < x < \pi \end{cases}$ as a full range Fourier series in the interval $(-\pi, \pi)$. Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots\infty = \frac{\pi^2}{8}$. (8)

(ii) Find the half-range sine series of $f(x) = 4x - x^2$ in the interval $(0, 4)$. Hence deduce the value of the series $\frac{1}{1^3} - \frac{1}{3^3} + \frac{1}{5^3} - \frac{1}{7^3} + \ldots\infty$. (8)

Or

(b) (i) Expand $f(x) = \sin x$ as a complex form Fourier series in $(-\pi, \pi)$. (8)

(ii) Compute the first three harmonics of the Fourier series for $f(x)$ from the following data : (8)

x :	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
$f(x)$:	1.0	1.4	1.9	1.7	1.5	1.2	1.0

12. (a) (i) Find the Fourier transform of $e^{-a|x|}$, $a > 0$ and hence deduce that

(1) $\int_0^\infty \frac{\cos xt}{a^2 + t^2} dt = \frac{\pi}{2a} e^{-a|x|}$

(2) $F\left\{xe^{-a|x|}\right\} = i\sqrt{\frac{2}{\pi}} \frac{2as}{\left(s^2 + a^2\right)^2}$, here F stands for Fourier transform. (8)

(ii) Solve for $f(x)$ from the integral equation (8)

$$\int_0^\infty f(x) \sin sx dx = \begin{cases} 1, & 0 \le s < 1 \\ 2, & 1 \le s < 2 \\ 0, & s \ge 2. \end{cases}$$

Or

(b) (i) Find the Fourier transform of $f(x) = \frac{1}{\sqrt{|x|}}$. (8)

(ii) Using Parseval's identity evaluate the following integrals

(1) $\int_0^\infty \frac{dx}{(a^2 + x^2)^2}$

(2) $\int_0^\infty \frac{x^2}{(a^2 + x^2)^2} dx$ where $a > 0$. (8)

13. (a) (i) Form the PDE by eliminating the arbitrary function from the relation $z = y^2 + 2f\left(\frac{1}{x} + \log y\right)$. (8)

(ii) Solve the Lagrange's equation $(x + 2z)p + (2xz - y)q = x^2 + y$. (8)

Or

(b) (i) Solve : $x^2p^2 + y^2q^2 = z^2$. (8)

(ii) Solve : $(D^2 + DD' - 6D'^2)z = y\cos x$. (8)

14. (a) A string is stretched and fastened to points at a distance 'l' apart. Motion is started by displacing the string in the form $y = a\sin\left(\frac{\pi x}{l}\right)$, $0 < x < l$, from which it is released at time $t = 0$. Find the displacement at any time t. (16)

Or

(b) An infinitely long rectangular plate with insulated surfaces is 10 cm wide. The two long edges and one short edge are kept at 0°C, while the other short edge $x = 0$ is kept at temperature

$u = 20y, \quad 0 \le y \le 5$

$u = 20(10 - y), \quad 5 < y \le 10$.

Find the steady state temperature distribution in the plate. (16)

15. (a) (i) Find the Z-transforms of $r^n \cos n\theta$ and $e^{-at} \cos bt$. (8)

(ii) Solve $u_{n+2} - 3u_{n+1} + 2u_n = 4^n$, given that $u_0 = 0$, $u_1 = 1$. (8)

Or

(b) (i) Using convolution theorem find inverse Z-transform of $\frac{z^2}{(z-a)(z-b)}$. (8)

(ii) Solve $y_{n+2} - 3y_{n+1} - 10y_n = 0$, given $y_0 = 1$, $y_1 = 0$. (8)

Reg. No. : [ ]

Question Paper Code : 97107

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Civil Engineering

MA 6351 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches except Environmental Engineering, Textile Chemistry, Textile Technology, Fashion Technology and Pharmaceutical Technology)

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Form the partial differential equation by eliminating the arbitrary function f from $z = f\left(\frac{y}{x}\right)$.

2. Find the complete solution of $p + q = 1$.

3. State the sufficient conditions for existence of Fourier series.

4. If $(\pi - x)^2 = \frac{\pi^2}{3} + 4\sum_{n=1}^{\infty}\frac{\cos nx}{n^2}$ in $0 < x < 2\pi$, then deduce that value of $\sum_{n=1}^{\infty}\frac{1}{n^2}$.

5. Classify the partial differential equation $(1-x^2)z_{xx} - 2xy\,z_{xy} + (1-y^2)z_{yy} + xz_x + 3x^2y\,z_y - 2z = 0$.

6. Write down the various possible solutions of one dimensional heat flow equation.

7. State and prove modulation theorem on Fourier transforms.

8. If $F\{f(x)\} = F(s)$, then find $F\{e^{iax}f(x)\}$.

9. Find the Z transform of n.

10. State initial value theorem on Z transforms.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the singular solution of $z = px + qy + p^2 - q^2$. (8)

(ii) Solve $(D^2 - 2DD')z = x^3y + e^{2x-y}$. (8)

Or

(b) (i) Solve $x(y-z)p + y(z-x)q = z(x-y)$. (8)

(ii) Solve $(D^3 - 7DD'^2 - 6D'^3)z = \sin(x+2y)$. (8)

12. (a) (i) Find the Fourier series of $f(x)=x^2$ in $-\pi<x<\pi$. Hence deduce the value of $\sum_{n=1}^{\infty}\frac{1}{n^2}$. (8)

(ii) Find the half range cosine series expansion of $(x-1)^2$ in $0<x<1$. (8)

Or

(b) (i) Compute the first two harmonics of the Fourier series of $f(x)$ from the table given. (8)

x	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$	2π
$f(x)$	1.0	1.4	1.9	1.7	1.5	1.2	1.0

(ii) Obtain the Fourier cosine series expansion of $f(x)=x$ in $0<x<4$. Hence deduce the value of $\frac{1}{1^4}+\frac{1}{3^4}+\frac{1}{5^4}$..... to ∞. (8)

13. (a) If a tightly stretched string of length l is initially at rest in equilibrium position and each point of it is given the velocity $\left(\frac{\partial y}{\partial t}\right)_{t=0}=v_0\sin^3\frac{\pi x}{l}$, $0<x<l$, determine the transverse displacement $y(x,t)$. (16)

Or

(b) A square plate is bounded by the lines $x=0$, $x=a$, $y=0$ and $y=b$. Its surfaces are insulated and the temperature along $y=b$ is kept at 100°C. while the temperature along other three edges are at 0°C. Find the steady - state temperature at any point in the plate. (16)

14. (a) Find the Fourier transform of $f(x)=\begin{cases}1-|x|, \text{ if } |x|<1\\ 0, \text{otherwise}\end{cases}$. Hence, deduce the values (i) $\int_0^{\infty}\frac{\sin^2 t}{t^2}dt$ (ii) $\int_0^{\infty}\frac{\sin^4 t}{t^4}dt$. (16)

Or

(b) (i) Find the Fourier transform of $e^{-a^2x^2}, a>0$. Hence show that $e^{\frac{-x^2}{2}}$ is self reciprocal under the Fourier transform. (8)

(ii) Evaluate $\int_0^{\infty}\frac{dx}{(x^2+a^2)(x^2+b^2)}$, using Fourier transforms. (8)

15. (a) (i) Find $Z(\cos n\theta)$ and $Z(\sin n\theta)$. (8)

(ii) Using Z-transforms, solve $u_{n+2}-3u_{n+1}+2u_n=0$ given that $u_0=0, u_1=1$. (8)

Or

(b) (i) Find the Z-transform of $\frac{1}{n(n+1)}$, for $n\geq 1$. (8)

(ii) Find the inverse Z-transform of $\frac{z^2+z}{(z-1)(z^2+1)}$, using partial fraction. (8)

Question Paper Code : 57502

B.E./B. Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Civil Engineering

MA 6351 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches except Environmental Engineering, Textile Chemistry, Textile Technology, Fashion Technology and Pharmaceutical Technology)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Form the partial differential equation by eliminating the arbitrary functions from $f(x^2 + y^2, z - xy) = 0$.

2. Find the complete solution of the partial differential equation $p^3 - q^3 = 0$.

3. Find the value of the Fourier series of $f(x) = \begin{cases} 0 & \text{in } (-c, 0) \\ 1 & \text{in } (0, c) \end{cases}$ at the point of discontinuity $x = 0$.

4. Find the value of b_n in the Fourier series expansion of $f(x) = \begin{cases} x + \pi & \text{in } (-\pi, 0) \\ -x + \pi & \text{in } (0, \pi) \end{cases}$

5. Classify the partial differential equation $u_{xx} + u_{xy} = f(x, y)$.

6. Write down all the possible solutions of one dimensional heat equation.

7. State Fourier integral theorem.

8. Find the Fourier transform of a derivative of the function $f(x)$ if $f(x) \to 0$ as $x \to \pm \infty$.

9. Find $Z\left\{\frac{1}{n!}\right\}$

10. Find $Z\{(\cos\theta + i\sin\theta)^n\}$.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Solve the equation $(x^2 - yz)p + (y^2 - zx)q = z^2 - xy$. **(8)**

(ii) Find the singular integral of the equation $z = px + qy + \sqrt{1 + p^2 + q^2}$. **(8)**

OR

(b) (i) Solve : $(D^3 - 2D^2D')z = 2e^{2x} + 3x^2y$. **(8)**

(ii) Solve : $(D^2 + 2DD' + D'^2 - 2D - 2D')z = \sin(x + 2y)$ **(8)**

12. (a) (i) Find the Fourier series of $f(x) = x$ in $-\pi < x < \pi$. **(6)**

(ii) Find the Fourier series expansion of $f(x) = |\cos x|$ in $-\pi < x < \pi$. **(10)**

OR

(b) (i) Find the half range sine series of $f(x) = x\cos\pi x$ in $(0, 1)$. **(8)**

(ii) Find the Fourier cosine series up to third harmonic to represent the function given by the following data : **(8)**

x :	0	1	2	3	4	5
y :	4	8	15	7	6	2

3. (a) Find the displacement of a string stretched between two fixed points at a distance of $2l$ apart when the string is initially at rest in equilibrium position and points of the string are given initial velocities v where $v = \begin{cases} \frac{x}{l} & \text{in } (0, l) \\ \frac{2l - x}{l} & \text{in } (l, 2l) \end{cases}$, x being the distance measured from one end. **(16)**

OR

(b) A long rectangular plate with insulated surface is l cm wide. If the temperature along one short edge is $u(x, 0) = k(lx - x^2)$ for $0 < x < l$, while the other two long edges $x = 0$ and $x = 1$ as well as the other short edge are kept at 0 °C, find the steady state temperature function $u(x, y)$. **(16)**

4. (a) Find the Fourier cosine and sine transform of $f(x) = e^{-ax}$ for $x \geq 0$, $a > 0$. Hence deduce the integrals $\int_0^\infty \frac{\cos sx}{a^2 + s^2} ds$ and $\int_0^\infty \frac{s \sin sx}{a^2 + s^2} ds$. **(16)**

OR

(b) (i) Find the Fourier transform of $f(x) = e^{-\frac{x^2}{2}}$ in $(-\infty, \infty)$. **(8)**

(ii) Find the Fourier transform of $f(x) = 1 - |x|$ if $|x| < 1$ and hence find the value of $\int_0^\infty \frac{\sin^4 t}{t^4} dt$. **(8)**

15. (a) (i) Find the Z-transforms of $\cos\frac{n\pi}{2}$ and $\frac{1}{n(n+1)}$. **(8)**

(ii) Using convolution theorem, evaluation $Z^{-1}\left\{\frac{z^2}{(z-a)^2}\right\}$. **(8)**

OR

(b) (i) Find the inverse Z-transform of $\frac{z}{z^2-2z+2}$ by residue method. **(8)**

(ii) Solve the difference equation $y_{n+2} + y_n = 2$, given that $y_0 = 0$ and $y_1 = 0$ by using Z-transforms. **(8)**

Reg. No. : [ ]

Question Paper Code : 27327

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Civil Engineering

MA 6351 — TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches except Environmental Engineering, Textile Chemistry, Textile Technology, Fashion Technology and Pharmaceutical Technology)

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Construct the partial differential equation of all spheres whose centres lie on the Z – axis, by the elimination of arbitrary constants.

2. Solve $(D+D'-1)(D-2D'+3)z=0$.

3. Find the root mean square value of $f(x)=x(l-x)$ in $0\le x\le l$.

4. Find the sine series of function $f(x)=1$, $0\le x\le \pi$.

5. Solve $3x\frac{\partial u}{\partial x}-2y\frac{\partial u}{\partial y}=0$; by method of separation of variables.

6. Write all possible solutions of two dimensional heat equation $\frac{\partial^2 u}{\partial x^2}+\frac{\partial^2 u}{\partial y^2}=0$.

7. If $F(s)$ is the Fourier Transform of $f(x)$, prove that $F\{f(ax)\}=\frac{1}{a}F\left(\frac{s}{a}\right), a\ne 0$.

8. Evaluate $\int_0^\infty \frac{s^2}{(s^2+a^2)(s^2+b^2)}ds$ using Fourier Transforms.

9. Find the Z – transform of $\frac{1}{n+1}$.

10. State the final value theorem. In Z transform.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find complete solution of $z^2(p^2+q^2)=(x^2+y^2)$. (8)

(ii) Find the general solution of $(D^2+2DD'+D'^2)z=2\cos y-x\sin y$. (8)

Or

(b) (i) Find the general solution of $(z^2-y^2-2yz)p+(xy+zx)q=(xy-zx)$. (8)

(ii) Find the general solution of $(D^2+D'^2)z=x^2y^2$. (8)

12. (a) (i) Find the Fourier series expansion the following periodic function of period 4 $f(x)=\begin{cases}2+x & -2\le x\le 0\\ 2-x & 0<x\le 2\end{cases}$. Hence deduce that $\frac{1}{1^2}+\frac{1}{3^2}+\frac{1}{5^2}+....=\frac{\pi^2}{8}$. (8)

(ii) Find the complex form of Fourier series of $f(x)=e^{ax}$ in the interval $(-\pi,\pi)$ where a is a real constant. Hence, deduce that $\sum_{n=-\infty}^{\infty}\frac{(-1)^n}{a^2+n^2}=\frac{\pi}{a\sinh a\pi}$. (8)

Or

(b) (i) Find the half range cosine series of $f(x)=(\pi-x)^2, 0<x<\pi$. Hence find the sum of series $\frac{1}{1^4}+\frac{1}{2^4}+\frac{1}{3^4}+....$ (8)

(ii) Determine the first two harmonics of Fourier series for the following data. (8)

x:	0	$\frac{\pi}{3}$	$\frac{2\pi}{3}$	π	$\frac{4\pi}{3}$	$\frac{5\pi}{3}$
$f(x)$:	1.98	1.30	1.05	1.30	–0.88	–0.25

13. (a) A tightly stretched string with fixed end points $x=0$ and $x=l$ is initially at rest in its equilibrium position. If it is vibrating by giving to each of its points a velocity $v=\begin{cases}\frac{2kx}{l} & in\ 0<x<\frac{l}{2}\\ \frac{2k(l-x)}{l} & in\ \frac{l}{2}<x<l\end{cases}$. Find the displacement of the string at any distance x from one end at any time t. (16)

Or

(b) A bar 10 cm long with insulated sides has its ends A and B maintained at temperature $50°C$ and $100°C$, respectively, until steady state conditions prevails. The temperature at A is suddenly raised to $90°C$ and at the same time lowered to $60°C$ at B. Find the temperature distributed in the bar at time t. (16)

14. (a) (i) Find the Fourier sine integral representation of the function $f(x)=e^{-x}\sin x$. (8)

(ii) Find the Fourier cosine transform of the function $f(x)=\frac{e^{-ax}-e^{-bx}}{x}, x>0$. (8)

Or

(b) (i) Find the Fourier transform of the function $f(x)=\begin{cases}1-|x|, & |x|\le 1\\ 0, & |x|>1\end{cases}$.

Hence deduce that $\int_0^\infty \left(\frac{\sin t}{t}\right)^4 dt=\frac{\pi}{3}$. (8)

(ii) Verify the convolution theorem for Fourier transform if $f(x)=g(x)=e^{-x^2}$. (8)

15. (a) (i) If $U(z)=\frac{z^3+z}{(z-1)^3}$, find the value of u_0, u_1 and u_2. (8)

(ii) Use convolution theorem to evaluate $z^{-1}\left\{\frac{z^2}{(z-3)(z-4)}\right\}$. (8)

Or

(b) (i) Using the inversion integral method (Residue Theorem), find the inverse Z- transform of $U(z)=\frac{z^2}{(z+2)(z^2+4)}$. (8)

(ii) Using the Z- transform solve the difference equation $u_{n+2}+4u_{n+1}+3u_n=3^n$ with $u_0=0, u_1=1$. (8)

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 80608

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016

Third Semester

Civil Engineering

MA 6351 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS

(Common to all branches except Environmental Engineering, Textile Chemistry, Textile Technology, Fashion Technology and Pharmaceutical Technology)

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the PDE of all spheres whose centers lie on the x-axis.

2. Find the complete integral of $\frac{z}{pq} = \frac{x}{q} + \frac{y}{p} + \sqrt{pq}$.

3. State the Dirichlet's conditions for a function $f(x)$ to be expanded as a Fourier series.

4. Expand $f(x) = 1$, in $(0, \pi)$ as a half-range sine series.

5. State the assumptions in deriving one-dimensional wave equation.

6. State the three possible solutions of the one-dimensional heat flow (unsteady state) equation.

7. State change of scale property on Fourier transforms.

8. Find the infinite Fourier sine transform of $f(x) = \frac{1}{x}$

9. State convolution theorem on Z-transform.

10. Find $Z\left[\frac{1}{n(n+1)}\right]$.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the partial differential equations of all planes which are at a constant distance 'k' units from the origin. (8)

(ii) Solve the Lagrange's equation $x(z^2 - y^2)p + y(x^2 - z^2)q = z(y^2 - x^2)$. (8)

Or

(b) (i) Form the PDE by eliminating the arbitrary functions 'f' and 'φ' from the relation $z = xf\left(\frac{y}{x}\right) + y\varphi(x)$. (8)

(ii) Solve $(D^2 + DD' - 6D'^2)z = y\cos x$. (8)

12. (a) (i) Expand $f(x) = x^2$ as a Fourier series in the interval $(-\pi, \pi)$ and hence deduce that $1 + \frac{1}{2^4} + \frac{1}{3^4} + \frac{1}{4^4} + \ldots = \frac{\pi^4}{90}$. (8)

(ii) Obtain the constant term and the coefficient of the first sine and cosine terms in the Fourier expansion of y as given in the following table: (8)

x	0	1	2	3	4	5
y	9	18	24	28	26	20

Or

(b) (i) Expand $f(x) = e^{-ax}, -\pi < x < \pi$ as a complex form Fourier series. (8)

(ii) Expand $f(x) = \begin{cases} x, & 0 < x < 1 \\ 2-x, & 1 < x < 2 \end{cases}$ as a series of cosines in the interval (0,2). (8)

13. (a) A tightly stretched string of length l with fixed end points is initially at rest in its equilibrium position. If it is set vibrating by giving each point a velocity $y_t(x,0) = v_0 \sin\left(\frac{3\pi x}{l}\right)\cos\left(\frac{\pi x}{l}\right)$, where $0 < x < l$. Find the displacement of the string at a point, at a distance x from one end at any instant 't'. (16)

Or

(b) A square plate is bounded by the lines $x=0, x=20, y=0, y=20$. Its faces are insulated. The temperature along the upper horizontal edge is given by $u(x,20) = x(20-x), 0 < x < 20$, while the other three edges are kept at 0°C. Find the steady state temperature distribution $u(x,y)$ in the plate. (16)

14. (a) (i) Find the Fourier transform of $f(x) = \begin{cases} 1-|x|, & |x| < 1 \\ 0, & |x| > 1 \end{cases}$ and hence deduce that $\int_0^\infty \left[\frac{\sin t}{t}\right]^4 dt = \frac{\pi}{3}$. (8)

(ii) Find the infinite Fourier sine transform of $f(x) = \frac{e^{-ax}}{x}$ hence deduce the infinite Fourier sine transform of $\frac{1}{x}$. (8)

Or

(b) (i) Find the infinite Fourier transform of $e^{-a^2x^2}$ hence deduce the infinite Fourier transform of $e^{-x^2/2}$. (8)

(ii) Solve the integral equation $\int_0^\infty f(x)\cos\lambda x\, dx = e^{-\lambda}$, where $\lambda > 0$. (8)

15. (a) (i) Find
(1) $Z[n^3]$ (2) $Z[e^{-t}t^2]$. (4+4)

(ii) Evaluate $Z^{-1}\left[\frac{9z^3}{(3z-1)^2(z-2)}\right]$, using calculus of residues. (8)

Or

(b) (i) Using convolution theorem, evaluate $Z^{-1}\left[\frac{z^2}{(z-a)(z-b)}\right]$. (8)

(ii) Using Z-transform, solve $y_{n+2} + 6y_{n+1} + 9y_n = 2^n$ given that $y_0 = y_1 = 0$. (8)

Reg. No. : [ ]

Question Paper Code : 73768

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third/Fifth Semester

Civil Engineering

MA 2211/MA 31/MA 1201 A/CK 201/080100008/080210001/10177 MA 301 – TRANSFORMS AND PARTIAL DIFFERENTIAL EQUATIONS/ MATHEMATICS – III

(Common to all branches)

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. If $f(x) = x^2$ in $(0, 2\pi)$ find the value of a_0 in the Fourier series expansion.

2. State Parseval's theorem on Fourier series.

3. Find the Fourier transform of $f(x) = \begin{cases} 1 \; for \; |x| < a \\ 0 \; for \; |x| > a \end{cases}$

4. State convolution theorem on Fourier sine transform.

5. Form the PDE by eliminating the arbitrary constants 'a' and 'b' from $z = ax^2 + by^2$.

6. Solve $\frac{\partial^2 z}{\partial x \partial y} = 0$.

7. Classify the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + 10(x^2 + y^2 - 10) = 0$.

8. What are the three possible solutions of one-dimensional wave equation?

9. State final value theorem on Z-transform.

10. Find Z-transform of nC_2.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Find the Fourier series expansion of $f(x) = x(2\pi - x)$ in $(0, 2\pi)$. (8)

(ii) Find the Fourier series expansion of $f(x) = \begin{cases} x-1 \text{ in } -\pi < x < 0 \\ x+1 \text{ in } 0 < x < \pi \end{cases}$. (8)

Or

(b) (i) Find the half range sine series of $f(x) = \begin{cases} x & \text{in } 0 < x < 1 \\ 2-x & \text{in } 1 < x < 2 \end{cases}$. (8)

(ii) Find the Fourier series expansion upto 2nd harmonic for the following data : (8)

x :	0	$\pi/6$	$\pi/3$	$\pi/2$	$2\pi/3$	$5\pi/6$
y :	10	12	15	20	17	11

12. (a) (i) Find the Fourier transform of $f(x)$ given by $f(x) = \begin{cases} x & \text{for } |x| \le a \\ 0 & \text{for } |x| > a \end{cases}$. (8)

(ii) Find the inverse Fourier transform of $\dfrac{1}{(1+s^2)^2}$. (8)

Or

(b) (i) Find $f(x)$ if $\int_0^\infty f(x)\cos x\, dx = \dfrac{\sin s}{s}$. (8)

(ii) Evaluate $\int_{-\infty}^{\infty} \dfrac{x^2}{(x^2+4)(x^2+9)} dx$ using Fourier sine transform. (8)

13. (a) (i) Form a PDE by eliminating arbitrary function 'f' and 'g' from $z = yf(x) + xg(y)$. (8)

(ii) Solve the equation $x^2(y-z)p + y^2(z-x)q = z^2(x-y)$. (8)

Or

(b) (i) Solve completely the equation $p^2 + q^2 = z$. (8)

(ii) Solve $(D^2 + 2DD' + D'^2)z = x^2y + e^{x-y}$. (8)

14. (a) A string is stretched between two fixed points at a distance l cm and the points of the string are given initial velocity $v = \lambda(lx - x^2)$ for $0 < x < l$. find the displacement function $y(x, t)$. (16)

Or

(b) A square plate has its faces and its edge $y = 0$ insulated. Its edges $x = 0$ and $x = 10$ are kept at temperature zero and its edge $y = 10$ at 100°C. Find the steady state temperature in the plate. (16)

15. (a) (i) Find Z-transform of $f(n)$ if

$$f(n) = \begin{cases} a^n & \text{for } 0 \le n \le N-1 \\ 0 & \text{otherwise} \end{cases}$$ (8)

(ii) Using Z-transform solve $y(n+2) - 4y(n) = 2^n$ given that $y(0) = 0 = y(1)$. (8)

Or

(b) (i) Find Z-transform of $\frac{2n+3}{(n+1)(n+2)}$. (8)

(ii) Find Inverse Z-transform of $\frac{z^2}{(z+a)^2}$ using convolution theorem. (8)

EE6352 ELECTRICAL ENGINEERING AND INSTRUMENTATION L T P C
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UNIT I DC MACHINES 9

Three phase circuits, a review. Construction of DC machines – Theory of operation of DC generators – Characteristics of DC generators- Operating principle of DC motors – Types of DC motors and their characteristics – Speed control of DC motors- Applications.

UNIT II TRANSFORMER 9

Introduction – Single phase transformer construction and principle of operation – EMF equation of transformer-Transformer no–load phasor diagram — Transformer on–load phasor diagram — Equivalent circuit of transformer – Regulation of transformer – Transformer losses and efficiency-All day efficiency –auto transformers.

UNIT III INDUCTION MACHINES AND SYNCHRONOUS MACHINES 9

Principle of operation of three-phase induction motors – Construction –Types – Equivalent circuit –Construction of single-phase induction motors – Types of single phase induction motors – Double revolving field theory – starting methods - Principles of alternator – Construction details – Types – Equation of induced EMF – Voltage regulation. Methods of starting of synchronous motors – Torque equation – V curves – Synchronous motors.

UNIT IV BASICS OF MEASUREMENT AND INSTRUMENTATION 9

Static and Dynamic Characteristics of Measurement – Errors in Measurement - Classification of Transducers – Variable resistive – Strainguage, thermistor RTD – transducer - Variable Capacitive Transducer – Capacitor Microphone - Piezo Electric Transducer – Variable Inductive transducer – LVDT, RVDT

UNIT V ANALOG AND DIGITAL INSTRUMENTS 9

DVM, DMM – Storage Oscilloscope. Comparison of Analog and Digital Modes of operation, Application of measurement system, Errors. Measurement of R, L and C, Wheatstone, Kelvin, Maxwell, Anderson, Schering and Wien bridges Measurement of Inductance, Capacitance, Effective resistance at high frequency, Q-Meter.

TOTAL (L: 45+T: 15): 60 PERIODS

TEXT BOOKS:

1. I.J Nagarath and Kothari DP, ‒Electrical Machines‖, McGraw-Hill Education (India) Pvt Ltd 4th Edition ,2010
2. A.K.Sawhney, ‒A Course in Electrical & Electronic Measurements and Instrumentation‖, Dhanpat Rai and Co, 2004.

UNIT-I DC MACHINES

1. What are the essential parts of a d.c generator?

1. Magnetic frame or yoke 2. Poles 3. Armature 4. Commutator, pole shoes, armature windings, interpoles 5. Brushes, bearings and shaft.

2. Give the materials used in machine manufacturing?

There are three main materials used in m/c manufacturing they are steel to conduct magnetic flux copper to conduct electric current insulation.

3. What are factors on which hysteresis loss?

It depends on magnetic flux density, frequency & volume of the material.

4. What is core loss? What is its significance in electric machines?

When a magnetic material undergoes cyclic magnetization, two kinds of power losses occur on it. Hysteresis and eddy current losses are called as core loss. It is important in determining heating, temperature rise, rating & efficiency of transformers, machines & other A.C run magnetic devices.

5. What is eddy current loss?

When a magnetic core carries a time varying flux, voltages are induced in all possible path enclosing flux. Resulting is the production of circulating flux in core. These circulating current do no useful work are known as eddy current and have power loss known as eddy current loss.

6. How hysteresis and eddy current losses are minimized?

Hysteresis loss can be minimized by selecting materials for core such as silicon steel & steel alloys with low hysteresis co-efficient and electrical resistivity. Eddy current losses are minimized by laminating the core.

7. How will you find the direction of emf using Fleming‘s right hand rule?

The thumb, forefinger & middle finger of right hand are held so that these fingers are mutually perpendicular to each other, then forefinger gives the direction of the lines of flux, thumb gives the direction of the relative motion of conductor and middle finger gives the direction of the emf induced.

8. How will you find the direction of force produced using Fleming‘s left hand rule?

The thumb, forefinger & middle finger of left hand are held so that these fingers are mutually perpendicular to each other, then forefinger gives the direction of magnetic field, middle finger gives the direction of the current and thumb gives the direction of the force experienced by the conductor.

9. What is the purpose of yoke in d.c machine?

1. It acts as a protecting cover for the whole machine and provides mechanical support for the poles.
2. It carries magnetic flux produced by the poles

10. What are the types of armature winding?

1. Lap winding, A=P,
2. Wave winding, A=2.

11. How are armatures windings are classified based on placement of coil inside the armature slots?

Single and double layer winding.

12. Write down the emf equation for d.c.generator?

E= (ΦNZ/60) (P/A) V.

p---------no of poles

Z---------Total no of conductor

Φ---------flux per pole

N---------speed in rpm.

13. Why the armature core in d.c machines is constructed with laminated steel sheets instead of solid steel sheets?

Lamination highly reduces the eddy current loss and steel sheets provide low reluctance path to magnetic field.

14. Why Commutator is employed in d.c.machines?

Conduct electricity between rotating armature and fixed brushes, convert alternating emf into unidirectional emf (mechanical rectifier).

15. Distinguish between shunt and series field coil construction?

Shunt field coils are wound with wires of small section and have more no of turns. Series field coils are wound with wires of larger cross section and have less no of turns.

16. How does d.c. motor differ from d.c. generator in construction?

Generators are normally placed in closed room and accessed by skilled operators only. Therefore on ventilation point of view they may be constructed with large opening in the frame. Motors have to be installed right in the place of use which may have dust, dampness, inflammable gases, chemical etc. to protect the motors against these elements the motor frames are used partially closed or totally closed or flame proof.

17. How will you change the direction of rotation of d.c.motor?

Either the field direction or direction of current through armature conductor is reversed.

18. What is back emf in d.c. motor?

As the motor armature rotates, the system of conductor come across alternate north and South Pole magnetic fields causing an emf induced in the conductors. The direction of the emf induced in the conductor is in opposite to current. As this emf always opposes the flow of current in motor operation it is called as back emf.

19. What is the function of no-voltage release coil in d.c. motor starter?

As long as the supply voltage is on healthy condition the current through the NVR coil produce enough magnetic force of attraction and retain the starter handle in ON position against spring force. When the supply voltage fails or becomes lower than a prescribed value then electromagnet may not

have enough force to retain so handle will come back to OFF position due to spring force automatically.

20. Enumerate the factors on which speed of a d.c.motor depends?

N= (V-IaRa)/Φ so speed depends on voltage applied to armature, flux per pole, resistance of armature.

21. Under what circumstances does a dc shunt generator fails to generate?

Absence of residual flux, initial flux setup by field may be opposite in direction to residual flux, shunt field circuit resistance may be higher than its critical field resistance; load circuit resistance may be less than its critical load resistance.

22. Define critical field resistance of dc shunt generator?

Critical field resistance is defined as the resistance of the field circuit which will cause the shunt generator just to build up its emf at a specified field.

23. Why is the emf not zero when the field current is reduced to zero in dc generator?

Even after the field current is reduced to zero, the machine is left out with some flux as residue so emf is available due to residual flux.

24. On what occasion dc generator may not have residual flux?

The generator may be put for its operation after its construction, in previous operation; the generator would have been fully demagnetized.

25. What are the conditions to be fulfilled by for a dc shunt generator to build back emf?

The generator should have residual flux, the field winding should be connected in such a manner that the flux setup by field in same direction as residual flux, the field resistance should be less than critical field resistance, load circuit resistance should be above critical resistance.

26. Define armature reaction in dc machines?

The interaction between the main flux and armature flux cause disturbance called as armature reaction.

27. What are two unwanted effects of armature reactions?

Cross magnetizing effect & demagnetizing effect.

28. What is the function of carbon brush used in dc generators?

The function of the carbon brush is to collect current from Commutator and supply to external load circuit and to load.

29. What is the principle of generator?

When the armature conductor cuts the magnetic flux emf is induced in the conductor.

30. What is the principle of motor?

When a current carrying conductor is placed in a magnetic field it experiences a force tending to move it.

31. What are different methods of speed control in D.C shunt motor?

1. Armature control2. Flux or field control3. Applied voltage control

32. When is a four point DC starter required in DC motors?

A four point DC starter is required for dc motor under field control

33. If speed is decreased in a dc motor, what happens to the back emf decreases and armature current?

If speed is decreased in a dc motor, the back emf decreases and armature current increases.

34. How does a series motor develop high starting torque?

A dc series motor is always started with some load. Therefore the motor armature current increases. Due to this, series motor develops high starting torque.

35. What is the necessity of starter in dc motors?

When a dc motor is directly switched on, at the time of starting, the motor back emf is zero. Due to this, the armature current is very high. Due to the very high current, the motor gets damaged. To reduce the starting current of the motor a starter is used.

36. Mention the types of braking of dc motor?

1. Regenerative braking2. Dynamic braking3. Plugging

37. What are the losses in dc motor?

1. Copper losses2. Iron losses3. Mechanical losses

38. Name any 2 non-loading method of testing dc machines?

1. Swinburne‘s test 2. Hopkinson test

UNIT-II TRANSFORMER

1. Define a transformer?

A transformer is a static device which changes the alternating voltage from one level to another.

2. What is the turns ratio and transformer ratio of transformer?

Turns ratio = N2/ N1

Transformer = E2/E1 = I1/ I2 =K

3. Mention the difference between core and shell type transformers?

In core type, the windings surround the core considerably and in shell type the core surrounds the windings i.e. winding is placed inside the core.

4. What is the purpose of laminating the core in a transformer?

In order to minimize eddy current loss.

5. Give the emf equation of a transformer and define each term?

Emf induced in primary coil E1= 4.44fΦmN1 volt emf induced in secondary

Coil E2 =4.44 fΦmN2.

f--------freq of AC input

Φ----------maximum value of flux in the core

N1, N2---------Number of primary & secondary turns.

6. Does transformer draw any current when secondary is open? Why?

Yes, it (primary) will draw the current from the main supply in order to magnetize the core and to supply for iron and copper losses on no load. There will not be any current in the secondary since secondary is open.

7. Define voltage regulation of a transformer?

When a transformer is loaded with a constant primary voltage, the secondary voltage

Decreases for lagging PF load, and increases for leading PF load because of its internal resistance and leakage reactance. The change in secondary terminal voltage from no load to full load expressed as a percentage of no loads or full load voltage is termed as regulation.

%regulation down= $(V_{2noload}- V_{2full\ load})*100/ V_{2noload}$,

%regulation up= $(V_{2noload}-V_{2F.L})*100/V_{2F.L}$

8. Define all day efficiency of a transformer?

It is computed on the basis of energy consumed during a certain period, usually a day of 24 hrs.

All day efficiency=output in kWh/input in kWh for 24 hrs.

9. Why transformers are rated in kVA?

Copper loss of a transformer depends on current & iron loss on voltage. Hence total losses depend on Volt-Ampere and not on PF. That is why the rating of transformers is in kVA and not in kW.

10. What determines the thickness of the lamination or stampings?

1. Frequency 2. Iron loss

11. What are the typical uses of auto transformer?

1. To give small boost to a distribution cable to correct for the voltage drop.
2. as induction motor starter.

12. What are the applications of step-up & step-down transformer?

Step-up transformer:

Step-up transformers are used in generating stations. Normally the generated voltage will be either 11kV. This voltage (11kV) is stepped up to 110kV or 220kV or 400kV and transmitted through transmission lines (simply called as sending end voltage).

Step-down transformer:

Step-down transformers are used in receiving stations. The voltage are stepped down to 11kV or 22kV are stepped down to 3phase 400V by means of a distribution transformer and made available at consumer premises. The transformers used at generating stations are called power transformers.

13. How transformers are classified according to their construction?

1. Core type 2.shell type. In core type, the winding (primary and secondary) surround the core and in shell type, the core surrounds the winding.

14. Explain on the material used for core construction?

The core is constructed by sheet steel laminations assembled to provide a continuous magnetic path with minimum of air gap included. The steel used is of high silicon content sometimes heat treated to produce a high permeability and a low hysteresis loss at the usual operating flux densities. The eddy current loss is minimized by laminating the core, the laminations being used from each other by light coat of core-plate vanish or by oxide layer on the surface. The thickness of lamination varies from 0.35mm for a frequency of 50Hz and 0.5mm for a frequency of 25Hz.

15. How does change in frequency affect the operation of a given transformer?

With a change in frequency, iron and copper loss, regulation, efficiency & heating varies so the operation of transformer is highly affected.

16. What is the angle by which no-load current will lag the ideal applied voltage?

In an ideal transformer, there are no copper & core loss i.e. loss free core. The no load current is only magnetizing current therefore the no load current lags behind by angle 900. However the winding possess resistance and leakage reactance and therefore the no load current lags the applied voltage slightly less than 900.

17. List the arrangement of stepped core arrangement in a transformer?

1. To reduce the space effectively
2. To obtain reduce length of mean turn of the winding
3. To reduce I2R loss.

18. Why are breathers used in transformers?

Breathers are used to entrap the atmospheric moisture and thereby not allowing it to pass on to the transformer oil. Also to permit the oil inside the tank to expand and contract as its temperature increases and decreases.

19. What is the function of transformer oil in a transformer?

1. It provides good insulation 2. Cooling.

20. Distinguish power transformers & distribution transformers?

Power transformers have very high rating in the order of MVA. They are used in generating and receiving stations. Sophisticated controls are required. Voltage ranges will be very high. Distribution transformers are used in receiving side. Voltage levels will be medium. Power ranging will be small in order of kVA. Complicated controls are not needed.

21. Name the factors on which hysteresis loss depends?

1. Frequency 2. Volume of the core 3. Maximum flux density

22. Why the open circuit test on a transformer is conducted at rated voltage?

The open circuit on a transformer is conducted at a rated voltage because core loss depends upon the voltage. This open circuit test gives only core loss or iron loss of the transformer.

23. What is the purpose of providing Taps in transformer and where these are provided?

In order to attain the required voltage, taps are provided, normally at high voltages side (low current).

24. What are the necessary tests to determine the equivalent circuit of the transformer?

1. Open circuit test 2. Short circuit test

25. Define regulation and efficiency of the transformer?

The regulation of the transformer is defined as the reduction in magnitude of the terminal voltage due to load, with respect to the no-load terminal voltage.

% regulation = (V2 on no-load- V2 when loaded/ V2 on no-load) x 100

Transformer efficiency in %= (output power/input power) x 100

UNIT-III INDUCTION MACHINES AND SYNCHRONOUS MACHINES

1. What are the 2 types of 3phase induction motor?

Squirrel cage and slip ring induction motor.

2. Write two extra features of slip ring induction motor?

Rotor has 3-phase winding. Extra resistance can be added in rotor circuit for improving PF with the help of three slip rings.

3. Why an induction motor is called as rotating transformer?

The rotor receives same electrical power in exactly the same way as the secondary of a two winding transformer receiving its power from primary. That is why induction motor is called as rotating transformer.

4. Why an induction motor never runs at its synchronous speed?

If the motor runs at synchronous speed then there would be no relative speed between the two, hence no rotor emf, so no rotor current, then no rotor torque to maintain rotation.

5. What are slip rings?

The slip rings are made of copper alloys and are fixed around the shaft insulating it. Through these slip rings and brushes rotor winding can be connected to external circuit.

6. What are the advantages of cage motor?

Since the rotor has low resistance, the copper loss is low and efficiency is very high. On account of simple construction of rotor it is mechanically robust, initial cost is less; maintenance cost is less, simple starting arrangement.

7. Give the condition for maximum torque for 3phase induction motor, when it is running?

The rotor resistance and reactance should be same for maximum torque i.e. $R_2=X_2$

8. List out the method for speed control of 3phase cage type induction motor?

By changing supply frequency

By changing no of poles

By operating the two motors in cascade

9. Name the two winding of single phase induction motor?

Running and starting winding.

10. What are methods available for making single phase induction motor a self starting?

By slitting the single phase, by providing shading coil in the poles.

11. What is the function of capacitor in single phase induction motor?

To make phase difference between starting and running winding, to improve PF and to get more torque.

12. State any 4 use of single phase induction motor?

Fans, wet grinders, vacuum cleaner, small pumps, compressors, drills.

13. What kind of motors used in ceiling fan and wet grinders?

Ceiling fan - Capacitor start and capacitor run single phase induction motor,

Wet grinders - Capacitor start capacitor run single phase induction motor.

14. What is the application of shaded pole induction motor?

Because of its small starting torque, it is generally used for small toys, instruments, hair driers, ventilators.etc.

15. In which direction a shaded pole motor runs?

The rotor starts rotation in the direction from unshaded part to the shaded part.

16. Why single phase induction motors have low PF?

The current through the running winding lags behind the supply voltage by large angle so only single phase induction motor has low PF.

17. Differentiate between –capacitor start‖ & –Capacitor start capacitor run‖ single Phase induction motor (IM)?

Capacitor start – capacitor run is connected series with starting winding, but it will be disconnected from supply when motor pick up its speed. Capacitor start capacitor run- starting winding and capacitor will not be disconnected from supply even though motor pickup its speed.

18. Explain why single phase induction motor is not a self starting one?

When motor fed supply from single phase, its stator winding produces an alternating flux, which doesn‘t develops any torque.

19. Define slip in an IM?

The slip of an IM is defined as the ratio of difference between sync. speed (Ns) and rotor speed (N) to the synchronous speed.

s= (Ns – N)/ Ns

20. Define slip speed in an IM?

The slip speed is defined as the difference in speed between the rotating magnetic field produced by stator (Ns) and rotor speed (N).

21. What is the speed of the rotor field in space?

The speed of the rotor field in space is speed of rotating field.

22. What is synchronous speed in 3-phase IM?

Ns = 120f/p

Where f- supply frequency

P- No of poles on the stator.

23. List the various methods of speed control of 3 phase IM?

Types of stator side control

1. Stator voltage control
2. Stator frequency control
3. v/f control
4. Pole changing method

24. In which type of motor can resistance be introduced in the rotor circuit? What is the effect of it?

Slip ring IM.

Effects:

1. Starting torque increased
2. starting current decreased
3. Motor speed can be controlled

25. What are the types of poly phase IM?

1. Squirrel cage IM
2. Slip ring IM

26. What will be the effect when stator voltage and freq of a IM are reduced proportionally?

1. Motor speed increases
2. Maximum torque is constant

27. What is slip power recovery scheme?

Slip power can be returned to the supply source and can be used to supply an additional motor which is mechanically coupled to the main rotor. This type of drive is known as slip power recovery system and improves overall efficiency of the system.

28. What are the principal advantages of rotating field type construction?

Relatively small amount of power required for field system can easily supplied to rotating system using slip rings and brushes, more space is available in the stator part of the machine to provide more insulation, it is easy to provide cooling system, stationary system of conductors can easily be braced to prevent deformation.

29. What are the advantages of salient type pole construction used in synchronous machines?

They allow better ventilation, the pole faces are so shaped radial air gap length increases from pole center to pole tips so flux distortion in air gap is sinusoidal so emf is also sinusoidal.

30. Why are alternators rated in KVA and not in KW?

As load increases I2R loss also increases, as the current is directly related to apparent power delivered by generator, the alternator has only their apparent power in VA/KVA/MVA as their power rating.

31. Why the sync. Impedance method of estimating voltage regulation is is considered as pessimistic method?

Compared to other method, the value of voltage regulation obtained by this method is always higher than the actual value so it is called as pessimistic method.

32. Why MMF method of estimating voltage regulation is considered as optimistic method?

Compared to EMF method, MMF method involves more no. of complex calculation steps. Further the OCC is referred twice and SCC is referred once while predetermining the voltage regulation for

each load condition. Reference of OCC takes core saturation effect. As this method require more effort, final result is very close to actual value, hence this method is called as optimistic method.

33. Define voltage regulation of the alternator?

It is defined as the increase in terminal voltage when full load is thrown off, assuming field current and speed remaining the same.

% reg = [(E0 – V)/V] x100

Where E0 = no terminal voltage V = full load rated terminal voltage

34. How is armature winding in alternators is different from those used in dc machines?

The armature winding of the alternator is placed in the stator, but in the case of dc machines the arm winding is placed in the rotor.

35. What is hunting how can it be prevented?

When a sync motor is used for driving a fluctuating load, the rotor starts oscillating about its new position of equilibrium corresponding to the new load. This is called hunting or phase swinging. To prevent hunting dampers are damping grids are employed.

36. What are different torqueses of synchronous motor?

1. Starting torque2. Running torque3. Pull-in torque4. Pull-out torque

37. Define step angle?

It is defined as angle through which the stepper motor shaft rotates for each command pulse. It is denoted as β, i)β=[(Ns-Nr)/ Ns.Nr]x360o

Where Ns = no. of stator poles or stator teeth

Nr = no. of rotor poles or rotor teeth

ii) β = 3600/mNr Where m= no. of stator poles

UNIT IV BASICS OF MEASUREMENT AND INSTRUMENTATION

1.What is an error?

The algebraic difference b/w the indicated value and the true value of the quantity to be measured is called an error.

2.What is calibration?

It is the process of making an adjustment or marking a scale so that the readings of an instrument agree with the accepted value and the certified standard.

3.When static characteristic are important?

The instruments measure the quantity which does not vary with time, the static characteristic of an instruments play an important role.

4.What is measurement?

The physical, chemical, electrical quantity, property, process, variable or a Condition to be measured is referred as measured

5.When dynamic characteristic of an instruments are important?

The instruments are subjected to rapidly varying inputs then it is necessary to study the dynamic relations between input &output.

6.What is accuracy?

It is the degree of closeness with which the instruments reading approaches the true value of the quantity to be measure.

7.What is precision?

It is the measure of consistency or measurements. It denotes the amount by which the individual readings are departed about the average value of readings.

8.What is sensitivity?

It denotes the smallest change in the measured variable to which the instruments to be responds. The units of sensitivity are in mm/unit quantity to be measure.

9.What is Threshold?

If the input quantity is slowly varied from zero onwards, the o/p does not vary until some min value of the input is reached.

10.What is resolution?

It is the smallest increment of quantity being measured which can be certainly detected by an instrument.

11.What is linearity?

It is the ability of an instrument to reproduce the input characteristic symmetrically & linearly.

12.What is the stability?

The ability of instruments to retain its performances through its specified operating life & the storage life is called stability.

13.What is tolerance?

The max allowable error in the measurement is specified in terms of a value is called tolerance.

14.What is a true value?

The actual value of a variable to be measured is called true value. This is practically impossible hence it is not possible to determine.

15.Which are standard inputs used to obtain dynamic behavior of an instruments?

The step, ramp, parabolic & sinusoidal i/p are used in practice to obtain the dynamic behavior of an instruments

16.What is fidelity?

It indicates how much faithfully the system reproduces the changes in the input. It is the ability of instruments to produce a wave shape identical to the wave shape of an input with respect to time.

17.What is setting time of instruments?

Before indicating the final reading the pointer of the instruments takes finite time, during which it oscillates or moves slowly to its final value.

18.What is a secondary instrument?

The instrument in which the reading shown by the instruments gives directly the measurements of the quantity to be measure is called secondary instruments.

19.What is an absolute instrument?

The instrument which gives the magnitude of the quantity to be measure in termers of the physical constant of the instruments is called absolute instruments.

20.How are the errors classified?

Gross errors also called personal errors, Random errors due to unknown reasons.

21.What is meant by measurement?

Measurement is an act or the result of comparison between the quantity and a predefined standard.

22.Mention the basic requirements of measurement.

The standard used for comparison purpose must be accurately defined and should be commonly accepted. The apparatus used and the method adopted must be provable.

23.What are the 2 methods for measurement?

Direct method and In direct method.

24.Explain the function of measurement system.

The measurement system consists of a transuding element which converts the quantity to be measured in an analogous form. The analogous signal is then processed by some intermediate means and is then fed to the end device which presents the results of the measurement.

25.Define Instrument.

Instrument is defined as a device for determining the value or magnitude of a quantity or variable.

26.List the types of instruments.

The 3 types of instruments are,

- Mechanical Instruments

- Electrical Instruments and
- Electronic Instruments.

27.Give the applications of measurement systems.

The instruments and measurement systems are sued for

- Monitoring of processes and operations.
- Control of processes and operations.
- Experimental engineering analysis.

28.Why calibration of instrument is important?

The calibration of all instruments is important since it affords the opportunity to check the instrument against a known standard and subsequently to errors in accuracy.

29.**Explain the calibration procedure.**

Calibration procedure involves a comparison of the particular instrument with either a primary standard or a secondary standard with a higher accuracy than the instrument to be calibrated or an instrument of known accuracy.

30.Define Calibration.

It is the process by which comparing the instrument with a standard to correct the accuracy.

31.What is an active transducer?

An element which produces electrical signal in the form of voltage or current d.c. or a.c. without using external power, when stimulated by any form of physical quantity is called an active transducer.

32.What is a passive transducer?

A transducer producing variation in the electrical parameters when stimulated in any form of physical quantity, requires an external excitation to, generate any electrical signal is called passive transducer.

33.What is the function of transducers?

It is a device which converters one form of energy into some other form. It is the main components in an instruments system.

34.Define transducer?

A transducer is a devices which converters one form of physical quantity into some another form of energy such as electrical, hydraulic pneumatic useful for measurements technique.

35.What is digital transducer?

It is devices which produce an electrical output in form of pulse whish forms a unique code generated for each discrete value sensed.

36.What do you mean by sensor & transducer?

Sensor: It is define as devices which produce a measurable response to change in a physical quantity.

Transducer: The transducer is devices which transform the output of a sensor to an electrical output.

37.What do you mean by analog transducer?

It converters the input quantity into an analog output which is a continuous function of time.

38.What is a thermocouple?

It is a temperature transducer. It is based on the principle that when heat is applied to the hot junction, a temperature difference exists b/w two junctions.

39.What is the application of thermistor?

The sensitivity of thermistor is large High sensitivity & high relativity Use for thermal conduction measurements.

40.What are thermistors?

Thermistor is a contraction of thermal- resistor. It is a semiconducting device which behaves as a thermal resistor having negative temp coefficient.

41.Which elements used in resistances thermometer?

Platinium, copper, nickel & tungsten.

42.What is the limitation of the thermistor?

a)Non-linear resistances vs. temperature characteristic

b) Not suitable over wide temperature.

43.Write the principle of operation of thermoelectric transducer?

It is based on the principle that the resistances of the material changes with change in temperature, generating thermal emf.

44.Mention any two salient features of RTD?

a)High accuracy b) Wide temperature range.

45.State see back effect?

When heat is applied to hot junction, a temperature difference exists b/w the two junctions, causing generation emf. The generated emf is proportional to the difference in the temperature.

46.What is POT?

It is poptentiometric resistive tranducer consisting a wore wound resistive component alone with a sliding contact called wiper

47.Mention the use of capacitive transducer?

It is used for the measurements of pressure, level, and displacement. It can also measure for linear & angular displacement.

48.Why is the capacitive transducer most useful for small system?

The force requirements of capacitive transducer are very small. Hence the power required to operate them is also very small.

49.What are the uses of LVDT?

a) Its displacement ranging from few mm to cm is to be measure

b) Use to measure force, weight, pressure

50.What is normal linear range of LVDT?

LVDT are available with range as low as ±0.05inch to as high as ±25 inch.

51.Which materials are used in piezoelectric transducer?

The material used in this is quartz, Rochelle & tourmaline

52.Name the transducer used for sensing acceleration?

a)Potentio metric accelerometer,

b)LVDT accelerometer,

c)piezo electric accelerometer,

d) Strain guage accelerometer,

53.What is shaft encoder?

It‘s a rotational displacement transducer which is used to measure the angular motion of a body about axis of rotation. it works on the principle whose displacement is to measure when rotates.

54.What is the advantage of digital shaft encoder?

c) It has only one disk

d) It rotate with body whose displacement is to be measure

55.What is optical encoder?

It is displacement transducer consisting of sector with pattern of alternator or randomly placed opaque & transparent areas.

UNIT V ANALOG AND DIGITAL INSTRUMENTS

1. **State the classification of measuring instruments?**

   Indicating instruments, recording instruments, integrating instruments.

2. **State the essentials torque required for successful operation of instruments?**

   i. Deflecting torque

   ii. Controlling torque

   iii. Damping torque.

3. **What are the various ways by which deflecting torque is produced?**

   - Magnetic effect
   - Thermal effect
   - Electrostatic effect
   - induction & hall effect.

4. **How controlling torque is produced?**

   Using springs, & using control weight the controlling torque is produced.

5. **Why scale of gravity is non-uniform?**

   The quantity is to measure is proportional to sin rather than in gravity control which is not a uniform. Hence scale calibrated is not in uniform.

6. **What are the different ways of producing damping torque in instruments?**

   a) Air friction damping,

   b) Fluid friction damping,

   c) Eddy current damping.

7. **What is the basic principle of PMMC instruments?**

   A current carrying coil placed in the permanent magnet field experiences a force, proportional to the current it carries.

8. **For which type of measurements PMMC devices are suitable?**

   It is suitable for d.c. only as in a.c. the torque produced on coli is reversing which cannot give accurate readings.

9. **State the principle of moving iron instruments?**

   A soft iron piece is brought near the magnets gets attracted by the magnet is the principle of moving iron attraction type instruments. When like polarities of magnet face each other they experiences a force of repulsion.

10. **List the possible cause of errors in moving iron instruments?**

    - hysteresis errors,
    - Temperature errors,
    - Stray magnetic field errors &Frequency & eddy current errors.

11. State the precautions to be taken while using D.C ammeters?

Never to be connected across the source of emf or load.

Must always in series.

Must connect in proper polarities.

12. What are the requirements of a shunt?

The temperature coefficient of shunt and the meter should be low& should be as equal as possible. The shunt resistances should be stable and constant with time.

13. What is sensitivity of volt meter?

S=1/full scale deflection current. Its unit is ohm/volt.

14. What is loading effect?

The low sensitive instruments is used in high resistances circuit then its gives a lower reading than the true reading.

15. State the precautions to be taken while using d.c. voltmeter?

The voltmeter resistances are very high & it should always be connected across the circuit or component whose voltage is to be measure.

16. What are the requirements of a multiplier?

a) Their resistances should not change with time.

b) They should not non-inductively wound for a.c.meters.

17. Which torque is absence in energy meter?

The controlling torque is absence in energy metering energy meter continues rotation of disc is required & it is not necessary to reset it to zero every time & hence controlling torque is absence.

18. What is an electronic voltmeter?

The voltmeter which uses rectifiers‘ diodes and other support ting electronic circuits to produce a current proportional to the quantity to be measured is called electronic voltmeter

19. State the advantage of an electronic voltmeter?

a) Low level signal detection

b) Low power consumption

c) Less loading effect

d) High sensitivity.

20. What is the basic principle used in potentiometer.

In potentiometer the unknown emf is measured by comparing it with a std known emf.

21. Name the potentiometer material used.

German silver, Maganetic wire

22. Define standardization.

It is the process by which adjusting the current flows through the potentiometer coil to make the voltage across the STD cell is equal.

23. State the applications of potentiometer.

Used for m/s of unknown emf

Used for ammeter calibration

Used for Voltmeter calibration

Used for wattmeter calibration

24. State the advantages of Crompton potentiometer.

More accurate

Easy to adjust

25. What are the practical difficulties in ac potentiometers?

More complicated

Accuracy is seriously affected

Difficulty is experienced in standardization.

26. Classify ac potentiometers.

Polar potentiometer

Coordinate potentiometer.

27. How the phase angle is measured in polar type potentiometers.

It is measured from the position of phase shifter.

28. Name some ac potentiometers.

Drysdale Tinsley potentiometer

Gall Tinsley potentiometer

29. State the advantages of ac potentiometers.

Can be used for m/s of both magnitude and phase angle

Can be used for m/s of inductance of the coil.

It is used in m/s of errors in CTS

30. State the applications of ac potentiometers.

Ammeter calibration

Voltmeter calibration

Wattmeter calibration.

31. State the use of ac bridges.

AC bridges are used for the m/s of self and mutual inductance and capacitance.

32. Name the bridge circuits used for the m/s of self inductance.

Maxwell‘s bridge

Maxwell-Wein Bridge

Anderson bridge

Hay‘s bridge.

33. Name the bridge circuits used for the m/s of capacitance.

DeSauty‘s bridge

Schering Bridge

Wein bridge

34. Name the bridge circuits used for the m/s of mutual inductance.

The Heaviside Campbell Bridge

The Campbell Bridge.

35. Which type of detector is used in ac bridges?

Vibration galvanometers are used.

Audio frequency and radio frequency oscillator.

36. In which cases audio frequency oscillators are used as ac source.

For high frequency ac requirement audio frequency oscillators are used.

37. Name the sources of errors in ac bridge m/s.

Errors due to stray magnetic fields

Leakage errors

Eddy current errors

Residual errors

Frequency and waveform errors.

38. State the advantages of Maxwell-wein Bridge.

The balance equation is independent of frequency and therefore more accurate.

39. State the disadvantage of Maxwell-wein Bridge.

This method needs a STD variable capacitor. Variable Capacitor is costliest.

40. State the disadvantages of Hay‘s bridge.

The balance equation is dependent of frequency and therefore any changes in Frequency will affect the m/s.

41. State the use of Wein Bridge.

It is used for the m/s of unknown capacitance and frequency.

42. What is the use of Campbell Bridge?

This is used for the m/s of mutual inductance.

43. What is meant by inductometer?

The std variable mutual inductance meter is called as inductometer.

44. Define Q-factor of the coil.

It is the ratio between powers stored in the coil to the power dissipated in the coil.

45. Name the components of iron loss.

Eddy current loss,Hysteresis loss.

46. **Name the faults that occur in cables.**
Break down of cable insulation

Short circuit fault

Open conductor fault.

47. **Name the loop test methods used in location of fault.**

Murray loop test

Varley loop test.

48. **How leakage errors are minimized in ac bridge circuits.**

By using high grade insulation.

49. **Classify resistance.**

Low resistance

Medium resistance

High resistance

50. **What is the range of medium resistance?**

Resistances of about 1 ohm to 100 kilo ohms are called medium resistance.

51. **Name the methods used for low resistance measurement.**

Ammeter – voltmeter method

Potentiometer method

Kelvin double bridge method

Ohm meter method.

52. **Name the methods used for medium resistance measurement**

Ammeter – voltmeter method

Substitution method

Wheatstone bridge method

Carey fosters bridge method.

53. **Where high resistance m/s is required?**

Insulation resistance of cables

High resistance circuit elements

Volume resistivity of a material, Surface resistivity.

54. **State the advantages of Wheatstone bridge method.**

Free from errors

The balance is quit independent of source emf

55. **State the advantages of Kelvin double bridge method.**

Errors owing to contact resistance, resistance of leads can be eliminated by using This Kelvin double bridge.

PART-B QUESTIONS

UNIT – I DC MACHINES

1. What is the principle on which d.c.generator works? List out the main parts of it. Write details about the construction and function main parts of it.
2. Describe the working principle of d.c generator and d.c motor with neat diagrams.
3. Write the expression for emf generated in d.c.machine?
4. Describe the different types of d.c.generators.. and discuss about its characteristics?
5. Draw the circuit models of d.c. generator and write relationship among the currents and voltage.
6. Derive the torque equation of dc motors?
7. Draw the mechanical characteristics of (N-T) of dc shunt and series of motors
8. Why series motors cannot be started without load.
9. Draw the diagram of three point starter and identified the various parts.
10. Describe the brake test on dc motors to determine the efficiency characteristics of dc motors.
11. Explain the Swinburne test to predetermine the efficiency of dc machine.

UNIT -2 TRANSFORMERS

1. What is Transformers? Define step up and step down Transformer?
2. Classify the transformers according to the construction?
3. Describe the construction of single phase Transformer?
4. Discuss about the working principle of transformers.
5. Derive the equation for the emf induced in a transformer?
6. What is an ideal transformer?
7. Draw and explain the no load vector diagram of ideal transformers and practical Transformers.
8. What are the two components of transformers no load current?
9. Explain the behavior of a transformer on load with relevant to phasor diagrams?
10. Derive the equivalent circuit of single phase two winding transformers?
11. Explain the OC and SC test on single phase transformers. Develop the equivalent circuit from the above tests?
12. Draw the phasor diagram and explain the operation of practical transformer on load?
13. Define voltage regulation. Draw the phasor diagram for lagging power factor and determine voltage regulation.

UNIT-3 INDUCTION MACHINES AND SYNCHRONOUS MACHINES

1. Explain the construction details of 3-phase IM and write its advantages.
2. With neat sketches discuss about the two types of 3-phase IM.
3. Derive the torque developed in 3-phase IM
4. Draw and explain the torque-slip characteristics of a 3-phase IM.
5. Draw and explain the power flow diagram of a 3-phase IM.
6. Develop a equivalent circuit for a 3-phase IM.

7. Explain about the different types of starters in a 3-phase IM and discuss about its operation.
8. Discuss the various methods of speed control in a 3-phase IM.
9. Derive an expression for the induced emf of an alternator
10. Explain the emf method to determine the voltage regulation of alternators.
11. Define voltage regulation. Name two methods used to determine voltage regulation of alternators.
12. Explain the construction and working principle of sync motor. Give the reasons for making two different types of rotors.
13. What are the advantages of having stationary armature winding in 3 phase synchronous generator? Mention some special features of sync machine.

UNIT IV BASICS OF MEASUREMENT AND INSTRUMENTATION

1. Give the methods of using any three standard input used for analyzing the dynamic response of a system with neat sketch.
2. Write briefly on instrument standards and its types with examples.
3. Why is feedback necessary in instrumentation system?
4. Explain briefly about the various types of errors.
5. Define and explain the arithmetic mean, average deviation, standard deviation.
6. Explain different strain gauges with a principle of operation.
7. Explain pressure capacitive transducer with neat diagram.
8. Explain the working principle of displacement transducers.
9. With neat diagram explain the potentiometer resistive transducers
10. Explain the working principle of LVDT with neat sketch.

UNIT V ANALOG AND DIGITAL INSTRUMENTS

1. Explain DVM with detail.
2. Explain digital Storage Oscilloscope.
3. Expalin Q meter and wein bridge in detail.
4.Explain maxewell bridge in detail
5. Explain Kelvins Bridge in detail
6. Explain Anderson Bridge in detail

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 97068

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Electronics and Communication Engineering

EE 6352 — ELECTRICAL ENGINEERING AND INSTRUMENTATION

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Draw the open circuit characteristics of D.C. Generator.

2. List the types of D.C. Motors. Give any one difference between them.

3. Define regulation in a transformer.

4. Draw the no load phasor diagram of a transformer.

5. Write the principle of operation of 3 phase induction motor.

6. Name the types of alternators.

7. Define 'errors' in measurement.

8. What is a transducer?

9. Compare analog and digital instruments.

10. Write the working principle of 'Q' meter.

PART B — (5 × 16 = 80 marks)

11. (a) Describe the construction and working of DC Generator. (16)

Or

(b) Explain the different methods of speed control of D.C. Motors. (16)

12. (a) (i) Derive Emf equation of a transformer. (10)

(ii) Draw equivalent circuit of a transformer. (6)

Or

(b) Discuss about

(i) Transformer losses and efficiency. (6)

(ii) Explain the working of Auto Transfer. (10)

13. (a) Describe the construction and working of 3 phase induction motor. (16)

Or

(b) (i) Discuss Methods of starting of synchronous motor. (10)

(ii) Discuss Torque Equation of synchronous motor. (6)

14. (a) Explain the working of the following sentences.

(i) Strain Gauge

(ii) Thermistor. (8+8)

Or

(b) Explain the operation of

(i) Capacitor microphone

(ii) Piezo Electric transducer. (8+8)

15. (a) With neat diagram explain the operation of storage oscilloscope.

Or

(b) With neat diagram explain the working of Wien's bridge for capacitance measurement.

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 51393

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2014.

Third Semester

Electronics and Communication Engineering

EC 2201/EC 32/EE 1204/080290008/10144 EC 302 — ELECTRICAL ENGINEERING

(Regulation 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the necessary conditions to be satisfied for the self excited DC generator to build up emf.
2. Give the reason for high starting current in a DC motor.
3. List out any four general application of Transformers.
4. Define voltage regulation of a Transformer.
5. Distinguish between squirrel cage and slip-ring induction motor.
6. Name any four types of single phase induction motors based on method of starting.
7. Find the speed at which a 6-pole Alternator is to be driven to obtain the Frequency of emf induced to be 50 Hz.
8. On what factors does the back emf induced on windings of Brushless DC motor depends?
9. State the advantages and limitation of high transmission voltage.
10. Write the desirable properties of transmission line insulators.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Briefly explain the load characteristics of different types of compound generators. (8)

(ii) Explain of speed control of DC series motor applying flux control technique. (8)

Or

(b) (i) Derive from the first principle an expression for the torque developed in a motor. (8)

(ii) A 400 V DC shunt motor takes 5 A on no-load at its rated speed. The armature resistance including that of brushes is 0.2 Ω and the normal field current is 2 A. Determine the efficiency of the machine as generator delivering load current of 30 A. (8)

12. (a) (i) Deriving emf equation of the transformer and show that the voltage induced in a Transformer per turn is the same whether it is primary or secondary. (8)

(ii) Develop equivalent circuit of 1-phase two winding transformer and hence obtain the total equivalent parameters referred to primary. (8)

Or

(b) A 220/440 V single-phase transformer has the following test results:

OC test: 220 V, 1A, 70 W on LV side

SC test : 20 V, 12 A, 100 W on HV side.

Obtain and draw the equivalent circuit parameters of the Transformer referred to LV side.

13. (a) (i) Describe briefly with necessary diagrams the constructional details of 3-phase squirrel cage induction motor. (8)

(ii) State the different methods of speed control of 3-phase induction motor and discuss any one method in brief. (8)

Or

(b) (i) Explain the step by step procedure for estimating the efficiency of 3-phase induction motor using equivalent circuit when the speed of operation is specified. (10)

(ii) Explain briefly why the plain single phase induction motor is not self starting. (6)

14. (a) A 3.3 kV alternator gave the following test results:

Field current (A)	16	25	37.5	50	70
OC voltage (kV)	1.55	2.45	3.3	3.75	4.15

A field current of 18 A is found to cause the full-load current to flow through the winding during short-circuit test. Predetermine the full-load voltage regulation at 0.8 power factor lagging by MMF method. Neglect winding resistance.

Or

(b) With neat sketches, explain the Full-step operation of variable reluctance stepper motors.

15. (a) (i) Draw a single line diagram of a typical ac power supply scheme. Mark the various components and state their significance. (10)

(ii) Discuss the advantages and disadvantages of dc transmission over ac transmission. (6)

Or

(b) (i) Describe the various parts of a high voltage single- core cable with a neat diagram. (6)

(ii) Draw the typical layout of 33 kV/11 kv substation showing all the protective devices. Assume there are 2 incoming feeders and 4 out going feeders (10)

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Question Paper Code : 91395

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Electronics and Communication Engineering

EC 2201/EC 32/EE 1204/080290008/10144 EC 302 — ELECTRICAL ENGINEERING

(Regulation 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the working principle of self excited generators with a diagram.
2. What are the factors that control motor speed?
3. Draw the equivalent circuit of a transformer.
4. Define regulation of a transformer. With expression and parameters.
5. Define 'slip' of an induction motor.
6. Draw the torque/speed curre of an induction motor.
7. What are the uses of dampers?
8. What is the principle of operation of Alternators?
9. What is a substation?
10. List out the type of overhead line insulators.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Draw and discuss the no-load and load characteristics of a shunt generator. (12)

(ii) What is the significance of back emf in motor? Explain in brief with expression. (4)

Or

(b) (i) Brief up the necessity of a starter? (4)

(ii) Distinguish between shunt and series motors. (4)

(iii) In a brake test, the effective load on the brake pulley was 38.1 kg, the effective diameter of the pulley 63.5 cm and speed 12 r.p.s. The motor took 49 A at 220 V. Calculate its efficiency. (8)

12. (a) Explain the construction and principle of operation of a transformer with neat diagrams. Also derive its emf equation. (16)

Or

(b) (i) With neat figures, discuss the open circuit and short circuit tests on transformer, and their purpose. (12)

(ii) Draw the vector diagram for a loaded transformer when load is non-inductive. (4)

13. (a) Explain the construction and principle of operation of three phase induction motor. (16)

Or

(b) (i) A 4 polo, 3-phase induction motor operates from a supply whose frequency is 50 Hz. Calculate the following ;

(1) the speed at which the field of the stator is rotating

(2) the speed of the rotor when the slip is 0.04

(3) the frequency of the rotor currents when the slip is 0.03.

(4) the frequency of the rotor currents at standstill. (6)

(ii) Explain why single phase induction motor is not self starting. (10)

14. (a) (i) What are the two types of rotors used in alternators? (4)

(ii) Derive the equation of induced emf of alternator. (4)

(iii) Find the synchronous impedance of an alternator in which a given field current produces an armature current of 200 A on short circuit and a generated emf of 50 V on open – circuit. The armature resistance is $0.1\,\Omega$. To what induced voltage must the alternator be excited if it is to deliver a load of 100 A at p.f. of 0.8 lagging, with a terminal voltage of 200 V. (8)

Or

(b) (i) Discuss the constriction and working principle of reluctance motor With appropriate diagram. (10)

(ii) Discuss the principle of stepper motor. With relevant diagram. (6)

15. (a) (i) Compare and contrast between EHVAC and EHVDC transmission systems. (8)

(ii) Write a detailed technical note on underground cables. (8)

Or

(b) Draw the typical layout of a substation and discuss the function of various equipment in it. (16)

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 77128

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Electronics and Communication Engineering

EE 6352 — ELECTRICAL ENGINEERING AND INSTRUMENTATION

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Mention the advantages of star and delta systems.

2. A 200 V DC motor has an armature resistance of 0.06 Ω and series field resistance of 0.04 Ω. If the motor input is 20 kW, find the back emf of the motor and power developed in armature.

3. Distinguish between core and shell type transformer.

4. What is an deal transformer and how does it differ from a practical transformer?

5. Mention the characteristic features of synchronous motor.

6. Compare slip ring and squirrel cage type rotor.

7. A thermistor has a resistance temperature coefficient β of –5%/°C. If the resistance of the thermistor is 100 Ω at 25°C, What is the resistance at 35°C?

8. What is piezoelectric effect?

9. Compare analog and digital instruments.

10. Write the advantages and disadvantages of Anderson bridge.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Explain the Internal and external characteristics of DC generator. (8)

(ii) A 10kW 250V, DC shunt generator is driven at 1000 rpm. Armature circuit resistance is 0.15 Ω and the field current is 1.64 A when the terminal voltage is 250V. Rotational losses are to be 540 W. Find at rated load armature induced emf, developed torque and efficiency. (8)

Or

(b) (i) Explain the characteristics of DC shunt and series motor. (8)

(ii) A 250V DC shunt motor has an armature resistance of 0.5Ω and a field resistance of 250Ω. When driving a constant load at 600 rpm the motor draws 21 A. What will be the new speed of the motor if an additional 250Ω resistance is inserted in the field circuit? (8)

12. (a) (i) A 20 kVA single phase transformer designed for 2000/200 V has the following constant : R_1 = 2.5Ω, X_1 = 8Ω, R_2 = 0.04Ω and X_2 = 0.07 Ω. Calculate the approximate value of the secondary terminal voltage and % regulation at full load and 0.8 p.f. lagging when primary applied voltage is 2000 V. (8)

(ii) Find "all day" efficiency of a transformer having maximum efficiency of 98% at 15 kVA at unity power factor and loaded as follows:

12 hours — 2kW at 0.5 p.f lag

6 hours — 12kW at 0.8 p.f lag

6 hours — at no load. (8)

Or

(b) (i) Deduce the equivalent circuit of transformer. (8)

(ii) A 1100 / 110 V, 22kVA single phase transformer has primary resistance and reactance 2 Ω and 5 Ω respectively. The secondary resistance and reactance are 0.02 Ω and 0.045 Ω respectively. Calculate:

(1) Equivalent resistance and reactance of secondary referred to primary.

(2) Total resistance and reactance referred to primary.

(3) Equivalent resistance and reactance of primary referred to secondary.

(4) Total resistance and reactance referred to secondary.

(5) Total copper loss. (8)

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Reg. No. | | | | | | | | | | | | |

Question Paper Code : 80370

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Electronics and Communication Engineering

EE 6352 — ELECTRICAL ENGINEERING AND INSTRUMENTATION

(Regulations 2013)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write the working principle of a DC motor.

2. Mention the types of DC series motor.

3. What is regulation of a transformer?

4. Derive the condition for maximum efficiency of single phase transformer.

5. What is slip in an induction motor?

6. Calculate the pitch factor for the winding with 36 slots 4 poles, coil span 1 to 8.

7. Define accuracy and resolution of a measuring instrument.

8. Write the principle of piezoelectric transducer.

9. Compare the important features of analog and digital instruments.

10. Define the Q factor.

PART B — (5 × 13 = 65 marks)

11. (a) With a neat diagram, explain the construction and function of different parts of a DC machine in detail. (13)

Or

(b) Explain in detail how the shunt motor behaves as a constant speed motor and the series motor as a variable speed motor. Hence discuss the applications of shunt, series and compound motor. (13)

12. (a) Explain open circuit and short circuit test on a single phase transformer. Deduce its equivalent circuit. (13)

Or

(b) Explain the operation of the transformer on load condition and draw the phasor diagram for lagging power factor. (13)

13. (a) Explain the working principle of a 3 phase induction motor. Hence derive the expression for its torque and obtain the condition for maximum torque. (13)

Or

(b) (i) Explain the working principle of a synchronous motor. (6)

(ii) Describe the constructional features of salient pole and smooth cylindrical type rotor of an alternator. (7)

14. (a) (i) Discuss the causes and method to minimize different types of errors. (8)

(ii) Compare the features of RTD, Thermocouple and thermistor. (5)

Or

(b) (i) Write short notes on capacitor Microphone. (5)

(ii) With equivalent circuit, Obtain the transfer function of LVDT. (8)

15. (a) Discuss the capacitance measurement using Wien Bridge and Schering's bridge and compare the merits & limitations of both the bridges.

Or

(b) With the block diagram, Explain the operation of storage oscilloscope.

PART C — (1 × 15 = 15 marks)

16. (a) (i) A 15 kVA, 2000/200 V transformer has an iron loss of 250W and full load copper Loss 350W. During the day it is loaded as follows :

No. of hours	Load	Power factor
9	¼ Load	0.6
7	Full load	0.8
6	¾ load	1.0
2	No load	–

Calculate the all-day efficiency. (10)

(ii) A 4-pole lap wound DC shunt generator has a useful flux/pole of 0.06 Wb. The armature winding consists of 200 turns, each turn having a resistance of 0.003 Ω. Calculate the terminal voltage when running at 1000 rpm if armature current is 45A. (5)

Or

(b) (i) What resistance range must resistor R_3 have in order to measure unknown resistor in the range of 1 – 100 kΩ using a Wheatstone bridge? Given $R_1 = 1$ kΩ and $R_2 = 10$ k Ω. (7)

(ii) Obtain the expression for frequency of Wien's bridge under balanced condition. (8)

———————

Reg. No. | | | | | | | | | | | | |

Question Paper Code : 57313

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Electronics and Communication Engineering

EE 6352 – ELECTRICAL ENGINEERING AND INSTRUMENTATION

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Faraday's law of electromagnetic induction is used in what type of DC machine ? Write its principle of operation.

2. Why is the starting current very high in a dc motor ?

3. Write down the EMF equation of a transformer.

4. Draw the phasor diagram of a transformer on no load.

5. Define "Slip" of a 3-phase induction motor.

6. A 3 phase, 50 Hz, 20 poles salient pole alternator must be run at what speed if it has star connected stator winding ?

7. How is the dynamic behaviour of a measuring system determined ? Name any common inputs to the system.

8. Write the principle of an LVDT.

9. Where do you use a Q-meter ?

10. For measuring unknown capacitance, what type of bridges are employed ?

PART – B (5 × 16 = 80 Marks)

11. (a) A 220 V dc shunt motor draws 4.5 A on no load and runs at 1000 rpm. Resistance of the armature winding and shunt field winding is 0.3 and 157 ohm respectively. Calculate the speed when loaded and drawing a current of 30 A. Assume that the armature reaction weakens the field by 3%.

OR

(b) Discuss the characteristics of DC generators and their theory of operation.

12. (a) (i) What is an ideal transformer and why the efficiency of a transformer is so high ?

(ii) Summarise the various transformer losses and write a note on auto transformers.

OR

(b) (i) What is known as the regulation of a transformer ?

(ii) The maximum efficiency of a 500 kVA, 3000/500 V, 50 Hz single phase transformer is 98% and occurs at 3/4 full load unity power factor. If the impedance is 100%, calculate the regulation at full load 0.8 power factor lagging.

13. (a) Explain the construction of the three phase induction motor. What are its types and give the equivalent circuit of the same.

OR

(b) (i) Enlist the various methods of starting of synchronous motors and derive the torque equation.

(ii) Write down the principle of operation of alternators and their constructional details.

14. (a) (i) How are the various transducers classified ?

(ii) Summarise the various errors you encounter in measurement.

OR

(b) (i) Point out the advantages and disadvantages of RTD.

(ii) Explain the working of a Piezo Electric transducer.

15. (a) With neat block diagram explain the operation of storage oscilloscope.

OR

(b) (i) A Maxwell bridge is used to measure an inductive impedance. The bridge constants at the balance are,

$C_1 = 0.02\ \mu F$; $R_1 = 510\ k\Omega$; $R_2 = 4.7\ k\Omega$ and $R_3 = 120\ k\Omega$.

Find the series equivalent of unknown impedance.

(ii) Find the equivalent parallel resistance and capacitance that causes a Wien bridge to null with the following component values.

$R_1 = 2.7\ k\Omega$; $C_1 = 5\ \mu F$; $R_2 = 22\ k\Omega$; $R_4 = 100\ k\Omega$.

The operating frequency is 2.2 kHz.

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EC6301 OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES L T P C 3 0 0 3

UNIT I DATA ABSTRACTION & OVERLOADING 9

Overview of C++ – Structures – Class Scope and Accessing Class Members – Reference Variables –Initialization – Constructors – Destructors – Member Functions and Classes – Friend Function –Dynamic Memory Allocation – Static Class Members – Container Classes and Integrators – Proxy Classes – Overloading: Function overloading and Operator Overloading

UNIT II INHERITANCE & POLYMORPHISM 9

Base Classes and Derived Classes – Protected Members – Casting Class pointers and Member Functions – Overriding – Public, Protected and Private Inheritance – Constructors and Destructors inderived Classes – Implicit Derived – Class Object To Base – Class Object Conversion – Composition Vs. Inheritance – Virtual functions – This Pointer – Abstract Base Classes and Concrete Classes –Virtual Destructors – Dynamic Binding

UNIT III LINEAR DATA STRUCTURES 10

Abstract Data Types (ADTs) – List ADT – array-based implementation – linked list implementation —singly linked lists –Polynomial Manipulation - Stack ADT – Queue ADT - Evaluating arithmetic expressions

UNIT IV NON-LINEAR DATA STRUCTURES 9

Trees – Binary Trees – Binary tree representation and traversals – Application of trees: Set Representation and Union-Find operations – Graph and its representations – Graph Traversals – Representation of Graphs – Breadth-first search – Depth-first search - Connected components

UNIT V SORTING AND SEARCHING 8

Sorting algorithms: Insertion sort - Quick sort - Merge sort - Searching: Linear search –Binary Search

TOTAL: 45 PERIODS

TEXT BOOKS:

1. Deitel and Deitel, “ C++, How To Program”, Fifth Edition, Pearson Education, 2005.
2. Mark Allen Weiss, “Data Structures and Algorithm Analysis in C++”, Third Edition, Addison- Wesley, 2007.

REFERENCES:

1. Bhushan Trivedi, “ Programming with ANSI C++, A Step-By-Step approach”, Oxford University Press, 2010.
2. Goodrich, Michael T., Roberto Tamassia, David Mount, “Data Structures and Algorithms in C++”, 7th Edition, Wiley. 2004.
3. Thomas H. Cormen, Charles E. Leiserson, Ronald L. Rivest and Clifford Stein, "Introduction to Algorithms", Second Edition, Mc Graw Hill, 2002.
4. Bjarne Stroustrup, “The C++ Programming Language”, 3rd Edition, Pearson Education, 2007.
5. Ellis Horowitz, Sartaj Sahni and Dinesh Mehta, Fundamentals of Data Structures in C++, Galgotia Publications, 2007.

Two Mark Questions and Answers

UNIT – I DATA ABSTRACTION & OVERLOADING

1. Difference between Class and structure? [April -2010, Dec-2012]

- Class is the ADT where as structure is UDT.
- Class needs access specifier such as private, public & private where as structure members can be accessed by public by default & don't need any access specifier. Class is oops where structure is borrowed from traditional structured [pop] concept.

2. What is abstract Class? [Nov-2009]

- An abstract class is a class that is designed to be specifically used as a base class. An abstract class contains at least one pure virtual function. You declare a pure virtual function by using a pure specifier [= 0] in the declaration of a virtual member function in the class declaration

3. List out the advantages of new operator over malloc[] [Dec-2012]

- It automatically computes the size of the data object.
- It automatically returns the correct pointer type
- It is possible to initialize the objects while creating_ the memory space.
- It can be overloaded.

4. What are the basic concepts of OOPS? [April -2011]

- Objects.
- Classes.
- Data abstraction and Encapsulation. Inheritance.
- Polymorphism.
- Dynamic binding.
- Message passing.

5. What are abstract classes? [Nov 2009, Apr 2013]

- Classes containing at least one pure virtual function become abstract classes. Classes inheriting abstract classes must redefine the pure virtual functions; otherwise the derived classes also will become abstract. Abstract classes cannot be instantiated.

6. Define abstraction and Encapsulation [Apr 2011]

Data Abstraction-Abstraction refers to the act of representing the essential features without including the background details or explanations.

Data Encapsulation-The wrapping up of data and functions into a single unit is known as data encapsulation.

7. What is the Need for Static Members.[April 2011]

- Class members can be declared using the storage class specifier static in the class member list. Only one copy of the static member is shared by all objects of a class in a program. When you declare an object of a class having a static member, the static member is not part of the class object.

8. Define Polymorphism. [Apr 2013]

- Polymorphism is another important oops concept. Polymorphism means the ability to take more than one form. For example, an operation may exhibit **different behavior in different instances**. Behavior depends upon the types of data used in the operation.

9. What do you mean by pure virtual functions? [Dec2008]

- A pure virtual member function is a member function that the base class forces derived classes to provide. Any class containing any pure virtual function cannot be used to create object of its own type.

10. List out the benefits of oops.

• Can create new programs faster because we can reuse code, • Easier to create new data types, Easier memory management,• Programs should be less bug-prone, as it uses a stricter syntax and type checking.

11. List out the application of oops.

- Client server computing
- Simulation such as flight simulations.
- Object-oriented database applications.
- Artificial intelligence and expert system
- Computer aided design and manufacturing systems.

1**2. Define data hiding.**

The purpose of the exception handling mechanism is to provide a means to detect and report an "exceptional circumstance" so that appropriate action can be taken.

13. What is the use of scope resolution operator?

In C, the global version of the variable cannot be accessed from within the inner block. C++ resolves this problem by introducing a new operator :: called the scope resolution operator. It is used to uncover a hidden variable.

Syntax:

:: variable name

14. When will you make a function inline?

When the function definition is small, we can make that function an inline function and we can mainly go for inline function to eliminate the cost of calls to small functions.

15. What is overloading?

Overloading refers to the use of the same thing for different purposes. There are 2 types of overloading:

• Function overloading

• Operator overloading

16. What is the difference between normal function and a recursive function? A recursive function is a function, which call it whereas a normal function does not. Recursive function can't be directly invoked by main function

17. What do you mean by friend functions?

C++ allows some common functions to be made friendly with any number of classes, thereby allowing the function to have access to the private data of thse classes. Such a function need not be a member of any of these classes. Such common functions are called friend functions.

18. Define dynamic binding.

Dynamic binding means that the code associated with a given procedure call is not known until the time of the call at run-time.

19. Write any four properties of constructor.(DEC 2010)

- Constructors should be declared in the public section.
- They are invoked automatically when the objects are created.
- They do not have return types
- They cannot be inherited

20. List any four Operators that cannot be overloaded.(DEC 2010) (DEC 2009) (DEC 2011)

Class member access operator (. , .*)
Scope resolution operator (::)
Size operator (sizeof)
Conditional operator (?:)

21. What is a Destructor? (DEC 2012)

A destructor is used to destroy the objects that have been created by a constructor. It is a special member function whose name is same as the class and is preceded by a tilde '~' symbol. When an object goes out from object creation, automatically destructor will be executed.

22. What is a Copy Constructor (DEC 2009)

A copy constructor is used to declare and initialize an object from another object. It takes a reference to an object of the same class as an argument
Eg: integer i2(i1);
would define the object i2 at the same time initialize it to the values of i1. Another form of this statement is
Eg: integer i2=i1;
The process of initializing through a copy constructor is known as copy initialization.

23. What is the Need for Destructors? (June 2013)

- Destructor is used to destroy an object.
- By destroying the object memory occupied by the object is released.

24. Explain the functions of Default Constructor(MAY 2011)

The main function of the constructor is, if the programmer fails to create a constructor for a class, then the compiler will create a constructor by default in the name of class name without having any arguments at the time of compilation and provides the initial values to its data members.

Since it is created by the compiler by default, the no argument constructor is called as default constructor.

25. What is the need for Overloading an operator(MAY 2011)

- To define a new relation task to an operator, we must specify what it means in relation to the class to which the operator is applied.
- This is done with the help of a special function called operator function.
- It allows the developer to program using notation closer to the target domain and allow user types to look like types built into the language.

26.What is the function of get and put function (MAY 2010)

- Cin.get(ch) reads a character from cin and stores what is read in ch.
- Cout.put(ch) reads a character and writes to cout

27. What are member functions?

Functions that are declared within the class definition are referred as member function.

UNIT-II INHERITANCE & POLYMORPHISM

1. What are the c++ operators that cannot be overloaded?

- Size operator (sizeof)
- Scope resolution operator (::)
- member access operators(. , .*)
- Conditional operator (?:)

2. What is a virtual base class?

When a class is declared as virtual c++ takes care to see that only copy of that class is inherited, regardless of how many inheritance paths exist between the virtual base class and a derived class.

3. What is the difference between base class and derived class?

The biggest difference between the base class and the derived class is that the derived class contains the data members of both the base and its own data members. The other difference is based on the visibility modes of the data members.

4. What are the rules governing the declaration of a class of multiple inheritance?

- More than one class name should be specified after the : symbol.
- Visibility modes must be taken care of.
- If several inheritance paths are employed for a single derived class the base class must be appropriately declared.

5. What is meant by inheritance?

Inheritance is the process by which objects of one class acquire the properties of another class. It supports the concept of hierarchical classification. It provides the idea of reusability. We can add additional features to an existing class without modifying it by deriving a new class from it.

6. Mention the types of inheritance.

1. Single inheritance.
2. Multiple inheritance.
3. Hierarchical inheritance.
4. Multilevel inheritance.
5. Hybrid inheritance.

7. Define dynamic binding.(APRIL/MAY 2010)

Dynamic binding means that the code associated with a given procedure call is not known until the time of the call at run-time.

8. What do u mean by pure virtual functions?

A pure virtual function is a function declared in a base class that has no definition relative to the base class. In such cases, the compiler requires each derived class to either define the function or redeclare it as a pure virtual function. A class containing pure virtual functions cannot be used to declare any objects of its own.

9. What are virtual functions?

A function qualified by the 'virtual' keyword is called virtual function. When a virtual function is called through a pointer, class of the object pointed to determine which function definition will be used.

10.Write some of the basic rules for virtual functions.

Virtual functions must be member of some class. They cannot be static members and they are accessed by using object pointers Virtual function in a base class must be defined. Prototypes of base class version of a virtual function and all the derived class versions must be identical. If a virtual function is defined in the base class, it need not be redefined in the derived class.

11.What is polymorphism? What are its types?

Polymorphism is the ability to take more than one form. An operation may exhibit different behaviors in different. The behavior depends upon the type of data used. Polymorphism is of two types. They are Function overloading, Operator overloading

12. What is meant by single inheritance?

If a single class is derived from a single base class is called single inheritance. Eg: Base class Derived class Here class A is the base class from which the class D is derived. Class D is the public derivation of class B hence it inherits all the public members of B. But D cannot access private members of B.

13.What is multiple inheritance?

If a class is derived from more than one base class, it is called multiple inheritance. Eg: Base classes Derived class .Here class C is derived from two base classes A & B.

14.What is hierarchical inheritance?

If a number of classes are derived from a single base class then it is called hierarchical inheritance. Eg : Hierarchical classification of students in University.

15.What is multilevel inheritance?

If a class is derived from a class, which in turn is derived from another class, is called multilevel inheritance. This process can be extended to any number of levels. Eg: Base class Grandfather , Intermediate , Base class Father , Derived class Child.

16. Define parameterized constructor.

constructor with arguments is called parameterized constructor Eg;Class integer{ int m,n;public:integer(int x,int y){ m=x;n=y;}To invoke parameterized constructor we must pass the initial values as arguments to the constructor function when an object is declared. This is done in two ways1.By calling the constructor explicitly eg: integer int1=integer(10,10);2.By calling the constructor implicitly eg: Integer int1(10,10);

17. Define copy constructor.

A copy constructor is used to declare and initialize an object from another object. It takes a reference to an object of the same class as an argument.

Eg: integer i2(i1);would define the object i2 at the same time initialize it to the values of i1. Another form of this statement is Eg: integer i2=i1;The process of initializing through a copy constructor is known as copy initialization.

18. **Explain one class to another class conversion with an example**.

Conversion from one class type to another is the combination of class to basic and basic to class type conversion. Here constructor is used in destination class and casting operator function isused in source class.

Eg: objX=objY

objX is the object of class X and objY is an object of class Y. The class Y type data is converted into class X type data and the converted value is assigned to the obj X. Here class Y is the source class and class X is the destination class.

19. Explain basic to class type conversion with an example.

Conversion from basic data type to class type can be done in destination class.

Using constructors does it. Constructor takes a single argument whose type is to be converted.

Eg: Converting int type to class type

```
class time

{

int hrs,mins;

public:

……….

Time ( int t) //constructor

{hours= t/60 ; //t in minutes

mins =t % 60;}}
```

20) What is meant by casting operator and write the general form of overloaded casting operator.

A casting operator is a function that satisfies the following conditions

- It must be a class member.
- It must not specify a return type.
- It must not have any arguments.

The general form of overloaded casting operator is

operator type name ( )

{

…….. // function statements

}

It is also known as conversion function.

UNIT – III LINEAR DATA STRUCTURES

1.Write down the definition of data structures? NOV DEC 2012

A data structure is a mathematical or logical way of organizing data in the memory that consider not only the items stored but also the relationship to each other and also it is characterized by accessing functions.

2. What is meant by an abstract data type (ADT)?

An ADT is a set of operation. A useful tool for specifying the logical properties of a data type is the abstract data type.ADT refers to the basic mathematical concept that defines the data type. Eg.Objects such as list, set and graph along their operations can be viewed as ADT's.

3. What is meant by list ADT?

List ADT is a sequential storage structure. General list of the form a1, a2, a3….., an and the size of the list is 'n'. Any element in the list at the position I is defined to be ai, ai+1 the successor of ai and ai-1 is the predecessor of ai.

4. What are the two parts of ADT?

- Value definition
- Operator definition

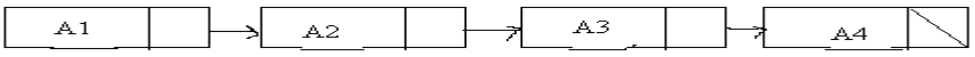
5. What is a Sequence?

A sequence is simply an ordered set of elements. A sequence S is sometimes written as the enumeration of its elements, such as

S =If S contains n elements, then length of S is n.

6. Define Linked Lists

Linked list consists of a series of structures, which are not necessarily adjacent in memory. Each structure contains the element and a pointer to a structure containing its successor. We call this theNext Pointer. The last cell'sNext pointer points to NULL.



7. State the different types of linked lists

The different types of linked list include singly linked list, doubly linked list and circular linked list.

8. List the basic operations carried out in a linked list

The basic operations carried out in a linked list include:

• Creation of a list
• Insertion of a node
• Deletion of a node
• Modification of a node
• Traversal of the list

9. List out the advantages of using a linked list

• It is not necessary to specify the number of elements in a linked list during its declaration
• Linked list can grow and shrink in size depending upon the insertion and deletion that occurs in the list
• Insertions and deletions at any place in a list can be handled easily and efficiently
• A linked list does not waste any memory space

10. List out the disadvantages of using a linked list

• Searching a particular element in a list is difficult and time consuming
• A linked list will use more storage space than an array to store the same number of elements

11. List out the applications of a linked list

Some of the important applications of linked lists are manipulation of polynomials, sparse matrices, stacks and queues.

12. What is a Stack?[NOV DEC 2008]

A Stack is an ordered collection of items into which new items may be inserted and from which items may be deleted at one end, called the top of the stack. The other name of stack is Last-in - First-out list.

13. List out the basic operations that can be performed on a stack

The basic operations that can be performed on a stack are

• Push operation
• Pop operation
• Peek operation
• Empty check
• Fully occupied check

14. State the different ways of representing expressions

The different ways of representing expressions are

• Infix Notation
• Prefix Notation
• Postfix Notation

15. State the rules to be followed during infix to postfix conversions

• Fully parenthesize the expression starting from left to right. During parenthesizing, the operators having higher precedence are first parenthesized.
• Move the operators one by one to their right, such that each operator replaces their corresponding right parenthesis

• The part of the expression, which has been converted into postfix is to be treated as single operand

16. State the difference between stacks and linked lists

The difference between stacks and linked lists is that insertions and deletions may occur anywhere in a linked list, but only at the top of the stack

17. What is a Priority Queue?[NOV DEC 2010]

Priority queue is a data structure in which the intrinsic ordering of the elements does determine the results of its basic operations. Ascending and descending priority queue are the two types of Priority queue.

18. Define a queue .

Queue is an ordered collection of elements in which insertions are restricted to one end called the rear end and deletions are restricted to other end called the front end. Queues are also referred as First-In-First-Out (FIFO) Lists.

19. State the difference between queues and linked lists

The difference between queues and linked lists is that insertions and deletions may occur anywhere in the linked list, but in queues insertions can be made only in the rear end and deletions can be made only in the front end.

20. What are the types of queues?

• Linear Queues – The queue has two ends, the front end and the rear end. The rear end is where we insert elements and front end is where we delete elements. We can traverse in a linear queue in only one direction ie) from front to rear.

• Circular Queues – Another form of linear queue in which the last position is connected to the first position of the list. The circular queue is similar to linear queue has two ends, the front end and the rear end. The rear end is where we insert elements and front end is where we delete elements. We can traverse in a circular queue in only one direction ie) from front to rear.

• Double-Ended-Queue – Another form of queue in which insertions and deletions are made at both the front and rear ends of the queue.

21. List the applications of stacks

- Towers of Hanoi
- Reversing a string
- Balanced parenthesis
- Recursion using stack
- Evaluation of arithmetic expressions

22. List the applications of queues

- Jobs submitted to printer
- Real life line
- Calls to large companies
- Access to limited resources in Universities
- Accessing files from file server

22. Why we need cursor implementation of linked lists?

Many languages such as BASIC and FORTRAN do not support pointers. If linked lists are required and pointers are not available, then an alternative implementation must be used known as cursor implementation.

23What is a linked list?

Linked list is a kind of series of data structures, which are not necessarily adjacent in memory. Each structure contain the element and a pointer to a record containing its successor.

24. What is a doubly linked list?

In a simple linked list, there will be one pointer named as 'NEXT POINTER' to point the next element, where as in a doubly linked list, there will be two pointers one to point the next element and the other to point the previous element location.

25. Define double circularly linked list?

In a doubly linked list, if the last node or pointer of the list, point to the first element of the list, then it is a circularly linked list.

UNIT – IV NON-LINEAR DATA STRUCTURES

1. Define non-linear data structure?

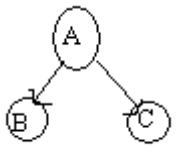
Data structure which is capable of expressing more complex relationship than that of physical adjacency is called non-linear data structure.

2. Define tree?

A tree is a data structure, which represents hierarchical relationship between individual Data items.

3. Define root.

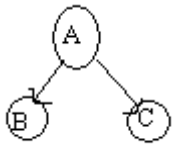
This is the unique node in the tree to which further sub-trees are attached.



Here, A is the root.

4. Define degree of the node

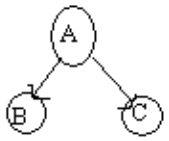
The total number of sub-trees attached to that node is called the degree of the node.



For node A, the degree is 2 and for B and C, the degree is 0.

5. Define leaves

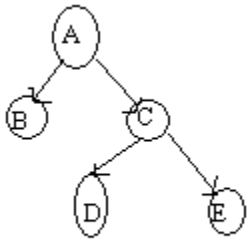
These are the terminal nodes of the tree. The nodes with degree 0 are always the leaves.



Here, B and C are leaf nodes.

6. Define internal nodes

The nodes other than the root and the leaves are called internal nodes.



Here, C is the internal node.

7. Define child and parent of a tree.

The root of each subtree is said to be a child of ‘r’ and ‘r’ is the parent of each subtree root.

8. Define leaf?

In a directed tree any node which has out degree o is called a terminal node or a leaf.

9. What is a Binary tree?

A Binary tree is a finite set of elements that is either empty or is partitioned into three disjoint subsets. The first subset contains a single element called the root of the tree. The other two subsets are themselves binary trees called the left and right sub trees.

10. What are the applications of binary tree?

Binary tree is used in data processing.

a. File index schemes

b. Hierarchical database management system

11. What is meant by traversing?

Traversing a tree means processing it in such a way, that each node is visited only once.

12. What are the different types of traversing?

The different types of traversing are

1. Pre-order traversal-yields prefix form of expression.
2. In-order traversal-yields infix form of expression.
3. Post-order traversal-yields postfix form of expression.

13. What are the two methods of binary tree implementation?

Two methods to implement a binary tree are,

1. Linear representation.
2. Linked representation

14. Define Graph?

A graph G consist of a nonempty set V which is a set of nodes of the graph, a set E which is the set of edges of the graph, and a mapping from the set for edge E to a set of pairs of elements of V.

It can also be represented as G=(V, E).

15. Define adjacent nodes?

Any two nodes which are connected by an edge in a graph are called adjacent nodes. For Example, if and edge xÎE is associated with a pair of nodes (u,v) where u, v Î V, then we say that the edge x connects the nodes u and v.

16. Name the different ways of representing a graph?

a. Adjacency matrix
b. Adjacency list

17. What are the two traversal strategies used in traversing a graph?

a. Breadth first search
b. Depth first search

18. What is an acyclic graph?

A simple diagram which does not have any cycles is called an acyclic graph.

19. Give some example of NP complete problems.

- Hamiltonian circuit.
- Travelling salesmen problems

20.What is meant by strongly connected in a graph?

An undirected graph is connected, if there is a path from every vertex to every other vertex. A directed graph with this property is called strongly connected.

21. When is a graph said to be weakly connected?

When a directed graph is not strongly connected but the underlying graph is connected, then the graph is said to be weakly connected

.

22.DifferentiateBFSandDFS.

No.	DFS	BFS
1.	Backtracking is possible from a	Backtracking is not possible
2.	Vertices from which exploration is incomplete are processed in a LIFO order	The vertices to be explored are organized as a FIFO queue

3.	Search is done in one particular direction	The vertices in the same level are maintained

23. What do you mean by tree edge?

If w is undiscovered at the time v w is explored, then v w is called a tree edge and v becomes the parent of w.

24. What do you mean by back edge?

If w is the ancestor of v, then v w is called a back edge.

25. Define biconnectivity.

A connected graph G is said to be biconnected, if it remains connected after removal of any one vertex and the edges that are incident upon that vertex. A connected graph is biconnected, if it has no articulation points.

26.What is a BST – binary search tree? (AUC NOV/ DEC 2009)

Binary search tree is a binary tree in which key values of the left sub trees are lesser than the root value and the key values of the right sub tree are always greater than the root value.

27. Define threaded Binary Tree.(AUC NOV/ DEC 2010)

A binary tree is threaded by making all right child 1 enters that would normally be null point to the inorder successor of the node, and all left child pointers that would normally be null point to the inorder predecessor of the node.

28.Write an algorithm to declare nodes of a tree structure.(AUC APR / MAY 2010)

```
Struct tree node
{
int  element;
Struct tree *left;
Struct tree *right;
}
```

29. Define articulation points.

If a graph is not disconnected, the vertices whose removal would disconnect the graph are known as articulation points

30. What is meant by Expression Tree? (Apr / May – 13)

An expression tree is a binary tree in which the operands are attached as leaf nodes and operators become the internal nodes.

UNIT – V SORTING AND SEARCHING

1. What is insertion sort?

One of the simplest sorting algorithms is the insertion sort. Insertion sort consist of N-1 passes. For pass P=1 through N-1 , insertion sort ensures that the elements in positions 0 through P-1 are in sorted order .It makes use of the fact that elements in position 0 through P-1 are already known to be in sorted order .

2. What is maxheap?Apr/May,2010

If we want the elements in the more typical increasing sorted order, we can change the ordering property so that the parent has a larger key than the child. it is called max heap.

3. What is divide and conquer strategy?

In divide and conquer strategy the given problem is divided into smaller problems and solved recursively. The conquering phase consists of patching together the answers. Divide and conquer is a very powerful use of recursion that we will see many times.

4. **Differentiate between merge sort and quick sort?Apr/May,2011**

Mergesort

1. Divide and conquer strategy 2. Partition by position

Quicksort

1. Divide and conquer strategy
2. Partition by value

5. Mention some methods for choosing the pivot element in quicksort?

1. Choosing first element
2. Generate random number
3. Median of three

6. What are the three cases that arise during the left to right scan in quicksort?

I and j cross each other

I and j do not cross each other I and j points the same position.

7. What is the need of external sorting?

External sorting is required where the input is too large to fit into memory. So external sorting is necessary where the program is too large.

It is a basic external sorting in which there are two inputs and two outputs tapes.

8. Define multi way merge? Apr/May,2011

If we have extra tapes then we can expect to reduce the number of passes required to sort.

10. What is divide and conquer strategy?

In divide and conquer strategy the given problem is divided into smaller problems and solved recursively. The conquering phase consists of patching together the answers. Divide and conquer is a very powerful use of recursion that we will see many times.

11. Differentiate between merge sort and quick sort?

Mergesort	Quicksort
1. Divide and conquer strategy	Divide and conquer strategy
2. Partition by position	Partition by value

12.Mention some methods for choosing the pivot element in quicksort?

1. Choosing first element
2. Generate random number
3. Median of three

13. What are the three cases that arise during the left to right scan in quicksort?

1. I and j cross each other
2. I and j do not cross each other
3. I and j points the same position

14. What is the need of external sorting?

External sorting is required where the input is too large to fit into memory. So external sorting is necessary where the program is too large.

15. Define two way merge?

It is a basic external sorting in which there are two inputs and two outputs tapes.

16. Define multi way merge?

If we have extra tapes then we can expect to reduce the number of passes required to sort our input. We do this by extending two way merge to a k-way merge.

17. Define polyphase merge?

The k-way merging strategy requires the use of 2 k tapes. This could be prohibitive for some applications. It is possible to get by with only k+1 tapes.

18. What is replacement selection?

Read as many records as possible and sort them. Writing the result to some tapes. This seems like the best approach possible until one realizes that as soon as the first record is written to a output tape the memory it used becomes available for another record. If the next record on the input tape is larger than the record we have just output then it can be included in the item. Using this we can give algorithm. This is called replacement selection.

19. What is sorting?

Sorting is the process of arranging the given items in a logical order.
Sorting is an example where the analysis can be precisely performed.

20. What is merge sort?

The merge sort algorithm is a classic divide and conquers strategy. The problem is divided into two arrays and merged into single array

21.What are the properties involved in heap sort? [Apr/May,2010[

1. Structure property
2. Heap order property

UNIT- I PART B (16 MARKS)

1. **Explain the basic concepts of OOPs.(FAQ in AU)**
2. **Explain about reference variables.**
3. **Discuss about function overloading. (Nov/Dec 2011)**
4. **What is operator overloading in C++. Explain with an example.(FAQ in AU)**
5. **Elaborate about container classes and integrators..**
6. **What is friend function? Explain with an example. (FAQ in AU)**
7. **Differentiate POP and OOP.**
8. **Define operator overloading. Explain the types.**
9. **Define inline function with an example program. Explain its implementation.**
10. **Write a member function and friend function to subtract two complex number in C++ (Nov/Dec 2014)**
11. **Write a member function to perform matrix addition, simple addition and string Concatenation by overloading + operator. (Nov/Dec 2014)**

UNIT II- PART B (16 MARKS)

1. **Explain about inheritance in detail. (FAQ in AU)**
2. **Discuss about virtual function and Dynamic programming.**
3. **Explain constructors in derived class. (FAQ in AU)**
4. **What is Abstract base class and concrete class. (Apr/may 2008)**
5. **Some program implementations.**
6. **Explain destructors in derived class.**
7. **Define constructors. Explain the types of constructor in detail.**
8. **Discuss about various access specifiers.**
9. **Write a C++ code to construct classes of a person with name and age as public properties, account detail as private properties and percentage of mark as protected property.**
   Construct a class to rank person based on the equal weight age to academic and sports details. Use inheritance concept. (Nov/Dec 2014)
10. **Explain Class Object to Base and Base to class Object conversion using C++ with suitable Example. (Nov/Dec 2014)**

UNIT III PART B (16 MARKS)

1. Explain top down design? (nov/dec 2010)
2.What is a Stack? Explain with example? (nov/dec 2013)
3.Write the algorithm for converting infix expression to postfix expression? (nov/dec 2011)
4.What is a Queue? Explain its operation with example? (Nov/dec 2013)
5.Explain the applications of stack? (Nov/dec 2011)
6.Write an algorithm for inserting and deleting an element from Doubly linked list? (Apr/may2011)

7. Explain the applications of Queue? (Nov/dec 2011)

8. Write an algorithm for inserting element from the stack? Explain linked implementation of Stack? (Apr/may2012)

9. Write an algorithm for inserting element from the queue? Explain linked implementation of queue ? (Apr/may2012)

10. Write the algorithm for converting infix expression to postfix expression for the following expression: (i) a+d-c/e*f +s-g

(ii) p*h+ c/e*f +s-g

11. Write C++ code to sum up all odd number in a single link list. Nov/dec 2014

12 Write C++ code to perform addition of two polynomials using link list form of queue. Nov/dec 2014

UNIT IV PART B (16 MARKS)

1. **Define Binary tree with its representation. (Nov/Dec 2012)**
2. **Explain Binary tree traversals. (Nov/Dec 2012)**
3. **Discuss in detail about graph and its representations.(FAQ in AU)**
   Adjacency list representation
   Adjacency matrix representation
4. **Convert the tree into traversals(FAQ in AU)**

```
      *
     / \
    /   \
   /     \
   +      +
  / \    / \
 /   \  /   \
 a    b c    7
```

The following would result from each traversal

*** pre-order : *+ab+c7**

*** in-order : a+b*c+7 * post-order: ab+c7+***

4. Discuss in detail about BFS with an example.(Nov/Dec 2013)

5. Discuss in detail about DFS with an example.(FAQ in AU)

6. Explain DFS and BFS with suitable example Nov/Dec 2014

7.Write C++ code for the implementation of different type of tree traversals State few tree applications. Nov/Dec 2014

UNIT V PART B (16 MARKS)

1. Explain Insertion sort with example?

2. Explain bubble sort and merge sort with example? (Nov/Dec 2012)

3. Explain quick sort with example?

4. Explain linear search with example?

5. Explain Binary search technique with example? (Nov/Dec 2012)

6.Difference between merge sort and quick sort.

7. Difference between linear search and binary search.

8. Write C++ code to implement Quick sort with suitable example. Write C++ code to implement linear search with suitable example. Nov/Dec 2014

9. Write C++ code to implement merge sort with suitable example. Write C++ code to implement binear search with suitable example. Nov/Dec 2014

17

Reg. No. : [ ]

Question Paper Code : 80332

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Electronics and Communication Engineering

EC 6301 — OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES

(Common to Biomedical Engineering and also common to Fourth Semester Medical Electronics, Robotics and Automation Engineering)

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is meant by default constructor?

2. State the difference between structure and class.

3. What is the role of this pointer?

4. Define virtual function.

5. What is a Data Structure? How it is classified?

6. List the applications of linked list.

7. What are the two ways of representing binary tree?

8. Differentiate breadth first and depth first search strategies.

9. What is the time complexity of linear search?

10. Name the sorting techniques which use the divide and conquer strategy.

PART B — (5 × 13 = 65 marks)

11. (a) Explain in detail about the features of object oriented programming. (13)

Or

(b) (i) Write a program for swapping two numbers using friend function. (6)

(ii) Write a program to find the area of a rectangle and triangle using function Overloading. (7)

12. (a) Explain the concept of composition with example. (13)

Or

(b) Describe the types of inheritance in C++ with an example. (13)

13. (a) Implement insertion, deletion and search operations in single linked list. (13)

Or

(b) Develop an algorithm to implement Queue ADT. Give relevant examples and diagrammatic representation. (13)

14. (a) Discuss the graph traversals with suitable algorithms and examples. (13)

Or

(b) Explain the algorithm for union and find operations in disjoint sets. (13)

15. (a) Explain the algorithm of Quick sort by sorting the following set of numbers as an example : 42 47 52 57 62 37 32 27 22. (13)

Or

(b) Write the algorithm to perform binary search on an array and demonstrate with an example. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Implement the ATM transaction in C++. (15)

Or

(b) Define an abstract class called Employee. Derive two classes called Hourly Employee and Salaried Employee. Hourly Employee has number of hours (integer), and wage per hour (float).

Salaried Employee has salary of type float. Calculate salary ( ) in an abstract function in class employee which inherited by derived classes. Write a main program to create objects of all classes and calculate salary of each object. (15)

Question Paper Code : 57280

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Electronics and Communication Engineering

EC 6301 -- OBJECT ORIENTED PROGRAMMING AND DATA STRUCTURES

(Common to Biomedical Engineering and also common to Fourth Semester Medical Electronics. Robotics and Automation Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Define constructor. List the type of constructor ?

2. List the operator that cannot be overloaded.

3. Write a simple C++ program to demonstrate the virtual functions.

4. State about cast operator.

5. Convert the infix expression a + b*c + (d*e + f)*g into postfix.

6. Define sentinel nodes, header node and tail node.

7. Draw expression tree for (a + b * c) + ((d * e + f) * g)

8. What do you mean by articulation points ?

9. List the advantages of quick sort.

10. Which search is faster and Why ?

PART – B (5 × 16 = 80 Marks)

11. (a) Discuss about function overloading with varying number of arguments and data types. (16)

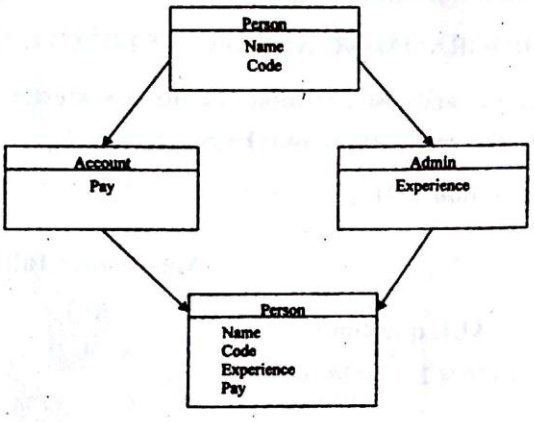
OR

(b) (i) List the characteristics of friend function. (4)

(ii) Write short notes on destructor. (4)

(iii) Explain in detail about static class member with employee class program. (8)

12. (a)



Consider the class network of above figure. The class **master** derives information from both account and admin classes which in turn derive information from the class **person**. Define all the four classes and write a program to create, update and display the information contained in **master** objects. (16)

OR

(b) Explain the polymorphism with example (16)

13. (a) (i) Write the ADT operation for insertion and deletion routine in stack. (8)

(ii) Explain the process of conversion from infix expression to postfix using stack. (8)

OR

(b) Discuss about addition of two polynomials using linked list with necessary ADT. (16)

. (a) Draw the binary search tree for the following input list 25, 45, 12, 60,75,92.10. Trace an algorithm to delete the nodes 25, 75, 10 from the tree. **(16)**

29

OR

(b) Discuss types of graph traversal and explain each with suitable examples. **(16)**

5. (a) (i) Write a c^{++} program to implement quick sort. **(8)**

(ii) Sort the sequence 4,7,2,0,-8,5 using Insertion sort. **(8)**

OR

(b) Explain the binary search with sample program. **(16)**

EC 6301 — Object Oriented Programming and Data Structures

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

(Common to Biomedical Engineering)

(Regulation 2013)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is destructor?
2. Define friend function.
3. Differentiate private and protected members of a class.
4. What is dynamic binding?
5. Define ADT?
6. What do you mean by queue ADT?
7. What is binary tree?
8. When a graph is said to be connected?
9. How an array elements are sorted using merge sort?
10. With an example compute the number of comparisons required to search an element Using binary search.

PART B — (5 × 16 = 80 marks)

11.a) Narrate on parameterized constructor and copy constructor with an example for each of them.(16)

or

b) i) What do you mean by function overloading and explain it with an example.(8)

ii) Elaborate on binary operator loading with an example.(8)

12. a) i) Explain base and derived classes with an example.(8)

ii) Write a program to illustrate how constructors are implemented when the classes are inherited? (8)

or

b) i) Give an account on virtual functions with an example.(8)

ii) Write a note on 'this' pointer with an example.(8)

13.a) i) Write a note on singly linked list.(8)

ii) Explain list ADT.(8)

or

b) Explain the applications of stack in detail.(16)

14. i) How can you construct an expression tree? Describe your answer with an example.(8)

ii) Discuss how sets are represented?(4)

iii) Explain union find operation.(4)

or

b) Describe in detail about breadth first search and depth first search in a graph.(16)

15. a) Explain quick sort in detail.(16)

Or

b) i) Describe binary search in detail.(8)

ii) Explain linear search in detail.(8)

Question Paper Code : 97058

Electronics and Communication Engineering

EC 6301 — Object Oriented Programming and Data Structures

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

(Common to Biomedical Engineering)

(Regulation 2013)

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Write a C++ code for swap of two variable using reference variable in function.
2. Write a C++ code to Display pen object instantiated and pen object destroyed When class for pen constructor and destructor are called .
3. Write a C++ code to Display as area of square or rectangle using function overloading?
4. Write a sample to code show the usage of this pointer in C++
5. Evaluate the value of expression ab+c*d using stack.
6. Find the maximum number of the node in complete binary tree if d is the depth.
7. Write short notes on connected components
8. Give the Representation of network of cities (Chennai, Delhi, Kolcutta and Mumbai) as weighted graph.
9. How to perform union operation?
10. What is the time complexity of quick sort and binary search?

PART B — (5 × 16 = 80 marks)

11. (a) Write a member function and friend function to subtract two complex number in C++ (16 marks)

Or

(b)Write a member function to perform matrix addition, simple addition and string concatenation by overloading + operator. (16marks)

12. (a) Write a C++ code to construct classes of a person with name and age as public properties, account detail as private properties and percentage of mark as protected property. Construct a class to rank person based on the equal weightage to academic and sports details. Use inheritance concept. (16 marks)

Or

(b) Explain Class Object to Base and Base to class Object conversion using C++ with suitable example. (16 marks)

13. (a) Write C++ code to sum up all odd number in a single link list. (16 marks)

Or

(b) Write C++ code to perform addition of two polynomials using link list form of queue.

14. (a) Explain DFS and BFS with suitable example (16 marks)

Or

(b) Write C++ code for the implementation of different type of tree traversals State few tree applications. (16 marks)

15. (a) Write C++ code to implement Quick sort with suitable example. Write C++ code to implement linear search with suitable example. (16 marks)

Or

(b) Write C++ code to implement merge sort with suitable example. Write C++ code to implement binear search with suitable example. (16 marks)

EC 2203 DIGITAL ELECTRONICS **L T P C**
3 1 0 4

UNIT I MINIMIZATION TECHNIQUES AND LOGIC GATES **12**

Minimization Techniques: Boolean postulates and laws – De-Morgan's Theorem -Principle of Duality - Boolean expression - Minimization of Boolean expressions —Minterm – Maxterm - Sum of Products (SOP) – Product of Sums (POS) – Karnaugh map Minimization – Don't care conditions - Quine-McCluskey method of minimization. **Logic Gates:** AND, OR, NOT, NAND, NOR, Exclusive–OR and Exclusive–NORImplementations of Logic Functions using gates, NAND–NOR implementations – Multi level gate implementations- Multi output gate implementations. TTL and CMOS Logic and their Characteristics – Tristate gates

UNIT II COMBINATIONAL CIRCUITS **12**
Design procedure – Half adder – Full Adder – Half subtractor – Full subtractor – Parallel binary adder, parallel binary Subtractor – Fast Adder - Carry Look Ahead adder – Serial Adder/Subtractor - BCD adder – Binary Multiplier – Binary Divider - Multiplexer/ Demultiplexer – decoder - encoder – parity checker – parity generators – code converters - Magnitude Comparator.

UNIT III SEQUENTIAL CIRCUITS **12**
Latches, Flip-flops - SR, JK, D, T, and Master-Slave – Characteristic table and equation –Application table – Edge triggering – Level Triggering – Realization of one flip flop using other flip flops – serial adder/subtractor- Asynchronous Ripple or serial counter – Asynchronous Up/Down counter - Synchronous counters – Synchronous Up/Down counters – Programmable counters – Design of Synchronous counters: state diagram- State table –State minimization –State assignment - Excitation table and maps-Circuit implementation - Modulo–n counter, Registers – shift registers - Universal shift registers – Shift register counters – Ring counter – Shift counters - Sequence generators.

UNIT IV MEMORY DEVICES **12**
Classification of memories – ROM - ROM organization - PROM – EPROM – EEPROM – EAPROM, RAM – RAM organization – Write operation – Read operation – Memory cycle - Timing wave forms – Memory decoding – memory expansion – Static RAM Cell- Bipolar RAM cell – MOSFET RAM cell – Dynamic RAM cell –Programmable Logic Devices – Programmable Logic Array (PLA) - Programmable Array Logic (PAL) – Field Programmable Gate Arrays (FPGA) - Implementation of combinational logic circuits using ROM, PLA, PAL

UNIT V SYNCHRONOUS AND ASYNCHRONOUS SEQUENTIAL CIRCUITS **12**
Synchronous Sequential Circuits: General Model – Classification – Design – Use of Algorithmic State Machine – Analysis of Synchronous Sequential Circuits **Asynchronous Sequential Circuits:** Design of fundamental mode and pulse mode circuits – Incompletely specified State Machines – Problems in Asynchronous Circuits – Design of Hazard Free Switching circuits. Design of Combinational and Sequential circuits using VERILOG

TUTORIAL =15, TOTAL : 60 PERIODS

TEXT BOOKS

1. M. Morris Mano, Digital Design, 3rd Edition, Prentice Hall of India Pvt. Ltd., 2003 / Pearson Education (Singapore) Pvt. Ltd., New Delhi, 2003.
2. S. Salivahanan and S. Arivazhagan, Digital Circuits and Design, 3rd Edition., Vikas Publishing House Pvt. Ltd, New Delhi, 2006

REFERENCES

1. John F.Wakerly, Digital Design, Fourth Edition, Pearson/PHI, 2006
2. John.M Yarbrough, Digital Logic Applications and Design, Thomson Learning, 2002.
3. Charles H.Roth. Fundamentals of Logic Design, Thomson Learning, 2003.

UNIT – I MINIMIZATIONTECHNIQUESANDLOGICGATES

1) Define binary logic?

Binarylogicconsistsofbinaryvariablesandlogicaloperations.Thevariablesare DesignatedbythealphabetssuchasA,B,C,x,y,z,etc.,witheachvariablehavingonlytwo distinctvalues:1and0.Therearethreebasiclogicoperations: AND, OR, and NOT.

2) Convert(9B2-1A)H to its decimal equivalent.

N=9x162+Bx161+2x160+1x16-1+A(10)x16-2

=2304+ 176+2+0.0625+0.039

=2482.110

3) State the different classification of binary codes?

1.Weightedcodes

2.Non-weightedcodes

3.Reflectivecodes

4.Sequentialcodes

5.Alphanumericcodes

6.ErrorDetectingandcorrectingcodes.

4**)List the different number systems?**

i)Decimal Number system

ii)Binary Number system

iii)Octal Number system

iv)Hexadecimal Number system

5)Write the names of basic logical operators.

1.NOT/INVERT

2.AND

3.OR

6)What are basic properties of Boolean algebra?

ThebasicpropertiesofBooleanalgebraarecommutativeproperty,associative Property and distributive property.

7)State the associative property of Boolean algebra.

TheassociativepropertyofBooleanalgebrastatesthattheORingofseveral variablesresultsinthesameregardlessofthegroupingofthevariables.Theassociative property is stated as follows:

A+(B+C)=(A+B)+C

8)State the commutative property of Boolean algebra.

Thecommutativepropertystatesthattheorderinwhichthevariablesare ORedmakesnodifference.Thecommutativepropertyis:

A+B=B+A

9)State the distributive property of Boolean algebra.

ThedistributivepropertystatesthatANDingseveralvariablesandORingthe resultWithasinglevariableisequivalenttoORingthesinglevariablewitheachofthe theseveralVariablesandthenANDingthesums.Thedistributivepropertyis:
A+BC=(A+B)(A+C)

10)State the absorption law of Boolean algebra.

The absorption law of Boolean algebra is given by X+XY=X,X(X+Y)=X.

11)State DeMorgan's theorem.

DeMorgan suggested two theorems that form important part of Boolean algebra.

They are,

1)The complement of a product is equal to the sum of the complements. (AB)'=A'+B'

2)The complement of a sum term is equal to the product of the complements. (A+B)'=A'B'

12)Reduce A(A+B)
A(A+B)=AA+AB
=A(1+B)[1+B=1]
=A.

13)Reduce A'B'C'+A'BC'+A'BC
A'B'C'+A'BC'+A'BC=A'C'(B'+B)+ A'B'C
=A'C'+A'BC[A+A'=1]
=A'(C'+BC)
=A'(C'+B)[A+A'B=A+B]

14)Reduce AB+(AC)'+AB’C(AB+C)
AB+(AC)'+AB’C(AB+C)=AB+(AC)'+AAB'BC+AB'CC
=AB+(AC)'+AB'CC[A.A'= 0]
=AB+(AC)'+AB'C[A.A=1]
=AB+A'+ C'=AB'C[(AB)'=A'+B']
=A'+B+C'+AB'C[A+AB'=A+B]
=A'+B'C+B+C'[A+A'B=A+B]
=A'+B+C'+B'C

=A'+B+C'+B'
=A'+C'+1
=1[A+1=1]

15. Simplify the following expression Y=(A+B)(A+C')(B'+C')
Y=(A+B)(A+ C')(B'+C')
=(AA'+AC+A'B+BC)(B'+C')[A.A'=0]
=(AC+ A'B+BC)(B'+C')
=AB'C+ACC'+A'BB'+A'BC'+ BB'C+ BCC'
=AB'C+A'BC'

16. Show that (X+Y'+XY)(X+Y')(X'Y)=0
(X+Y'+XY)(X+Y')(X'Y)=(X+Y'+X)(X+Y')(X'+Y)[A+A'B=A+B]
=(X+Y')(X+Y')(X'Y)[A+A=1]
=(X+Y')(X'Y)[A.A= 1]
=X.X'+Y'.X'.Y
=0[A.A'=0]

17. Prove that ABC+ABC'+AB'C+A'BC=AB+AC+BC
ABC+ABC'+ AB'C+A'BC=AB(C+C')+AB'C+A'BC
=AB+AB'C+A'BC
=A(B+B'C)+A'BC
=A(B+ C)+A'BC
=AB+AC+A'BC
=B(A+ C)+AC
=AB+BC+AC
=AB+AC+BC...Proved

18. Convert the given expression in canonical SOP form Y=AC+AB+ BC
Y=AC+AB+BC
=AC(B+B')+AB(C+C')+(A+A')BC
=ABC+ABC'+AB'C+AB'C'+ABC+ABC'+ABC
=ABC+ABC'+AB'C+AB'C'[A+ A=1]

19. Define duality property.

Dualitypropertystatesthateveryalgebraicexpressiondeduciblefromthe postulatesOfBooleanalgebraremainsvalidiftheoperatorsandidentityelementsare interchanged.IfthedualofanalgebraicexpressionisdesiredwesimplyinterchangeORand ANDoperatorsandreplace1'sby0'sand0'sby1's.

20.FindthecomplementofthefunctionsF1=x'yz'+x'y'zandF2=x(y'z'+yz). By applying De-Morgan's theorem.

F1'=(x'yz'+x'y'z)'=(x'yz')'(x'y'z)'=(x+y'+ z)(x+y+z')
F2'=[x(y'z'+yz)]'=x'+(y'z'+yz)'

=x'+(y'z')'(yz)'

=x'+(y+z)(y'+z')

21 Simplify the following expression

Y=(A+B)(A=C)(B+C)

=(AA+AC+AB+BC)(B+C)

=(AC+AB+BC)(B+C)

=ABC+ ACC+ABB+ABC+BBC+ BCC

=ABC

22WhatarethemethodsadoptedtoreduceBooleanfunction?

i)Karnaugmap

ii)TabularmethodorQuineMc-Cluskeymethod

iii)Variableenteredmaptechnique.

23)State the limitations of karnaugh map.

i)Generally it is limited to six variable map(i.e)more then six variable involving expression are not reduced.

ii)The map method is restricted in its capability since they are useful for simplifying only Boolean expression represented in standard form.

24)What are called don't care conditions?

In some logic circuits certain input conditions never occur, therefore the Corresponding output never appears. In such cases the output levelisnot defined,itcanbeeitherhighorlow.Theseoutputlevelsareindicatedby'X'or'd'inthetruth tables and are called don't care conditions orin completely specified functions.

25)What is a prime implicant?

A prime implicant is a product term obtained by combining the maximum possible number of adjacent squares in the map.

26)What is an essential implicant?

If a minterm is covered by only one prime implicant, the prime implicant is said to be essential

27.What is a Logic gate?

Logic gates are the basic elements that make up a digital system. The electronic gate Is a circuit that is able to operate on a number of binary inputs in order to perform a Particular logical function.

28.What is High Threshold Logic?

Some digital circuits operate in environments, which produce very high noise signals. For operation in such surroundings there is available at type DTL gate which Possesses a high threshold to noise immunity. This type of gate is called HTL logic or High Threshold Logic.

29.WhatarethetypesofTTLlogic?

1.Opencollectoroutput

2.Totem-PoleOutput
3.Tri-stateoutput.

30. What is depletion mode operation MOS?

Ifthechannelisinitiallydopedlightlywithp-typeimpurityaconductingchannel existsatzerogatevoltageandthedeviceissaidtooperateindepletionmode.

31.What is enhancement mode operation of MOS?

Iftheregionbeneaththegateisleftinitiallyunchargedthegatefieldmust induce achannelbeforecurrentcanflow.Thusthegatevoltageenhancesthechannelcurrent and such a device is said to operate in the enhancement mode.

32.MentionthecharacteristicsofMOStransistor?

1.Then-channelMOSconductswhenitsgate-to-sourcevoltageispositive.
2.Thep-channelMOSconductswhenitsgate-to-sourcevoltageisnegative
3.Eithertypeofdeviceisturnedofifitsgate-to-sourcevoltageiszero.

33.ListthedifferentversionsofTTL

1.TTL(Std.TTL)
2.LTTL(LowPowerTTL)
3.HTTL(HighSpeedTTL)
4.STTL(SchottkyTTL)
5.LSTTL(LowpowerSchottkyTTL)

34.Why totem pole outputs cannot be connected together.

Totem pole outputs cannot be connected together because such a connection might produce excessive current and may resulting damage to the devices.

UNIT-IICOMBINATIONALCIRCUITS

1. Definecombinationallogic

When logic gates are connected together to produce a specified output for certain Specified combinations of input variables ,with no storage involved, the resulting circuit is Called combinational logic.

2.Explainthedesignprocedureforcombinationalcircuits

The problem definition Determine the number of available input variables & required O/P variables. Assigning letter symbols to I/O variables

Obtain simplified Boolean expression for each O/P.

Obtain the logic diagram.

3.Define Half adder and full adder

The logic circuit that performs the addition of two bits is a half adder. The circuit that Performs the addition of three bits is a full adder.

4. **Define Decoder?**

A decoder is a multiple-input multiple output logic circuit that converts coded input sin to coded outputs where the input and output codes are different.

5. What is binary decoder?

A decoder is a combinational circuit that converts binary information from n input lines to a maximum of 2n outputs lines.

6. Define Encoder?

An encoder has 2n input lines and n output lines. In encoder the output lines generate The binary code corresponding to the input value.

7.WhatispriorityEncoder?

A priority encoder is an encoder circuit that includes the priority function. In priority encoder, if 2 or more inputs are equal to 1at the same time, the input having The highest Priority will take precedence.

8.Definemultiplexer?

Multiplexer is a digital switch .I fallows digital information from several sources to be Routed on to a single output line.

9.What do you mean by comparator?

A comparator is a special combinational circuit designed primarily to compare the Relative magnitude of two binary numbers.

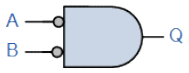
10.Listbasictypesofprogrammablelogicdevices.

.Read only memory

.Programmable logic Array

.Programmable Array Logic

11. Find the relation between the inputs and output shown in figure. Name the operation performed.

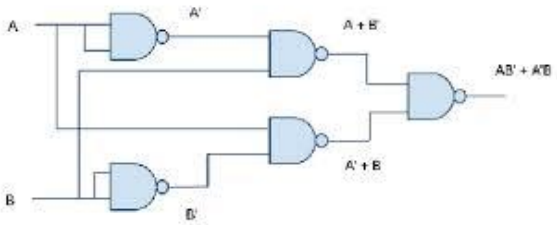


$\overline{A}\,.\overline{B}=\overline{A+B}$

12. Write the truth table of a 4:1 multiplexer

Select	Input's	Output
S0	**S1**	**Y**
0	0	I0
0	1	I1
1	0	I2
1	1	I3

13. Draw the exclusive –OR gate logic using only NAND gates.



14. Suggest a solution to overcome the limitation on the speed of an adder.

One method of speeding up this process by eliminating inter stage carry delay is called look-ahead carry addition. This method utilizes logic gates to look at the lower order bits of the augends and addend to see if a higher order carry is to be generated. It uses two functions.

Carry generate

Carry propagate

15. Differentiate a decoder from a demultiplexer.

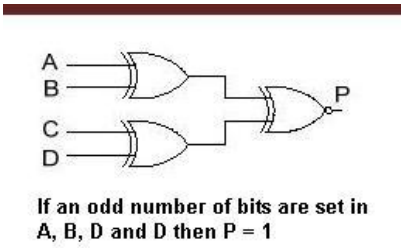
S.No	Decoder	Demultiplexer
1.	A decoder is a multiple input multiple output logic circuit with converts coded input into coded outputs, where the input and output codes are different.	A demultiplexer is a circuit that receivers information on a single line and transmits this information on one of 2n possible output lines.

16. Write an expression for barrow and difference in a full subtractor circuits.

For Borrow: $D=\bar{A}\bar{B}B_{in}+\bar{A}B\bar{B}_{in}+ABB_{in}$

For Difference: $Bout=\bar{A}B_{in}+\bar{A}B+BB_{in}$

17. Draw the circuit diagram for 4 bit odd parity generator.



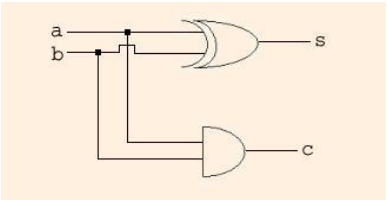
18. Relate carry generate, carry propagate, sum and carry out of a carry look ahead adder.

Sum $=Si=Pi\oplus Ci$

Carry $=C_{i+1}=Gi+PiCi$

19. Design a half-adder combinational circuit to produce the outputs. Sum and barrow.

AB	**S**	**C**
00	0	0
01	1	0
10	1	0
11	0	1



20. Write the logic expressions for the difference and barrow of a half subtractor.

Difference$=A\bar{B}+AB=A\oplus B$

Borrow $=\bar{A}B$

21. Design a single bit magnitude comparator to compare two words A& B.

A B	A=B	A>B	A<B
00	1	0	0
01	0	0	1
10	0	1	0
11	1	0	0

UNIT-IIISEQUENTIALCIRUITS

1. What are the classifications of sequential circuits?

The sequential circuits are classified on the basis of timing of their signals into two types. They are,

1) Synchronous sequential circuit.

2) Asynchronous sequential circuit.

2. Define Flip flop.

The basic unit for storage is flip flop. A flip-flop maintains its output state either at1or0untildirectedbyaninputsignaltochangeitsstate.

3. What are the different types of flip-flop?

There are various types of flip flops. Some of them are mentioned below they are,

RS flip-flop
SR flip-flop
D flip-flop
JK flip-flop
T flip-flop

4. What is the operation of RS flip-flop?

When R input is low and S input is high the Q output of flip-flop is set.
When R input is high and S input is low the Q output of flip-flop is reset.
When both the inputs R and S are low the output does not change
When both the inputs R and S are high the output is unpredictable.

5. What is the operation of SR flip-flop?

- When R input is low and S input is high the Q output of flip-flop is set.
- When R input is high and S input is low the Q output of flip-flop is reset.
- When both the inputs R and S are low the output does not change.
- When both the inputs R and S are high the output is unpredictable.

6. What is the operation of Dflip-flop?

InDflip-flopduringtheoccurrenceofclockpulseifD=1,theoutputQissetand if D=0,theoutputisreset.

7.WhatistheoperationofJKflip-flop?

- When K input is low and J input is high the Q output of flip-flop is set.
- When K input is high and J input is low the Q output of flip-flop is reset.
- When both the inputs K and J are low the output does not change
- When both the inputs K and J are high it is possible to set or reset the flip-flop(ie) the output toggle on then extpositive clock edge.

8.WhatistheoperationofTflip-flop?

T flip-flop is also known as Toggle flip-flop.

When T=0thereisnochangeintheoutput.

When T=1theoutputswitchtothecomplementstate(ie)the output toggles.

9. Define race around condition.

InJKflip-flopoutputisfedbacktotheinput.Thereforechangeintheoutput results Change in the input. Due to this in the positive half of the clock pulse if both J and K are high then output toggles continuously. This condition is called ‘race around condition’.

10.What is edge-triggered flip-flop?

The problem of race around condition can solved by edge triggering flip flop. The term edge triggering means that the flip-flop changes state either at the positive edge or negative edge of the clock pulse and it is sensitive to its inputs only at this transition of the clock.

11.Whatisamaster-slaveflip-flop?

A master-slave flip-flop consists of two flip-flops where one circuit serves as a master And the other as a slave.

12. Define rise time.

Thetimerequiredtochangethevoltagelevelfrom10%to90%isknownasrise time(tr).

13. Define fall time.

Thetimerequiredtochangethevoltagelevelfrom90%to10%isknownasfall time(tf).

14. Define skew and clock skew.

The phase shift between the rectangular clock wave form is referred to as skew and The time delay between the two clock pulses is called clock skew.

15. Define setup time.

The setup time is the minimum time required to maintain a constant voltage level sat the excitation inputs of the flip-flop device prior to the triggering edge of the clock pulse in order for the levels to be reliably clocked into the flipflop. It is denoted as t setup.

16.Defineholdtime.

The hold time is the minimum time for which the voltage levels at the excitation inputs must remain constant after the triggering edge of the clock pulse in order for the levels to be reliably clocked into the flip flop. It is denoted as hold.

17. Define propagation delay.

A propagation delay is the time required to change the output after the application of the input.

18. Define registers.

A register is a group of flip-flops flip-flop can store one bit information. So ann- bit register has a group of n flip-flops and is capable of storing any binary information /number containing n-bits.

19. Define shift registers.

The binary information in a register can be moved from stage to stage within the register or into or out of the register up on application of clock pulses. This type of bit movement or shifting is essential for certain arithmetic and logic operations used in microprocessors. This gives rise to group of registers called shift registers.

20. What are the different types of shift type?

There are five types. They are,

- Serial In Serial Out Shift Register
- Serial In Parallel Out Shift Register
- Parallel In Serial Out Shift Register
- Parallel In Parallel Out Shift Register
- Bi directional Shift Register

21. Explain the flip-flop excitation tables for Dflip-flop

In Dflip-flop then ext state is always equal to the D input and it is independent of the Present state. Therefore D mustbe0ifQn+1hasto0,andifQn+1hastobe1 Regardless the value of Qn.

22.Explain the flip-flop excitation tables for Tflip-flop

WheninputT=1thestateoftheflip-flopiscomplemented;whenT=0,thestate of the

Flip-flopremainsunchanged.Therefore,for0_0and1_1transitionsTmustbe0 and for

0_1and1_0transitionsmustbe1.

23.Define sequential circuit?

In sequentialcircuitstheoutputvariablesdependentnotonlyonthepresent input variablesbuttheyalsodependuponthepasthistoryoftheseinputvariables.

24. Give the comparison between combinational circuits and sequential circuits.

Combinational circuits Sequential circuits

Memory unit is not required Memory unity is required

ParalleladderisacombinationalcircuitSerialadderisasequentialcircuit

25.What do you mean by present state?

The information stored in the memory elements at any given time define. the present State of the sequential circuit.

26.What do you mean by next state?

The present state and the external inputs determine the outputs and the next state of The sequential circuit.

27.State the types of sequential circuits?

1.Synchronoussequentialcircuits

2.Asynchronoussequentialcircuits

28.Define synchronous sequential circuit

In synchronous sequential circuits, signals can affect the memory elements only at discrete instant of time.

29.Define Asynchronous sequential circuit?

In asynchronous sequential circuits change in input signals can affect memory element at any instant of time.

30. Give the comparison between synchronous & Asynchronous sequential circuits?

Synchronous sequential circuits Asynchronous sequential circuits.

Memory elements are clocked flip-flops Memory elements are either unlocked flip-flops or time delay elements. Easier to design More difficult to design

31. Define flip-flop

Flip-flop is a sequential device that normally sample sits inputs and changes its outputs only at times determined by clocking signal.

32. What is race around condition?

In the JK latch ,the output is feedback to the input, and therefore changes in the output

Results change in the input. Due to this in the positive half of the clock pulse if J and K are both high then output toggles continuously. This condition is known as race around condition.

33. What are the types of shift register?

1.Serialinserialoutshiftregister

2.Serialinparalleloutshiftregister

3.Parallelinserialoutshiftregister

4.Parallelinparalleloutshiftregister

5.Bidirectionalshiftregistershiftregister

UNIT IV MEMORY DEVICES

1. Explain rom

A read-only memory (ROM)is device that includes both the decoder and the OR gates with in a single IC package. It consists of n input lines and m output lines. Each bit Combinationoftheinputvariablesiscalledanaddress.Eachbitcombinationthat comes out oftheoutputlinesiscalledaword.Thenumberofdistinctaddressespossible with n input variablesis2n.

2. What are the types of ROM?

1. PROM

2. EPROM

3. EEPROM

3. Explain PROM.

PROM(Programmable Read Only Memory)

Itallowsusertostoredataorprogram.PROMsusethefuseswithmateriallike nichromeandpolycrystalline.Theusercanblowthesefusesbypassingaround 20to50mAofcurrentfortheperiod5to20µs.Theblowingoffusesiscalled programming of ROM. The PROMs are one time programmable .Once programmed, the information is stored permanent.

5. **Explain EPROM.**

EPROM (Erasable Programmable Read Only Memory)

EPROMuseMOScircuitry.Theystore1’sand0’sasapacketofchargeina buried layer of the IC chip. We can erase the stored data in the EPROMs by exposing the chiptoultravioletlightviaitsquartzwindowfor15to20 minutes .It is not possible to erases elective information. The chip can be reprogrammed.

6. **Explain EEPROM**.

EEPROM (Electrically Erasable Programmable Read Only Memory)

EEPRO Malsouse MOS circuitry. Data is stored as charge orno charge onan insulated layer or an insulated floating gate in the device .EEPRO Mallows selectiveerasingattheregisterlevelratherthanerasingalltheinformation since the information can be changed by using electrical signals.

6.DefineROM

A read only memory is a device that includes both the decoder and the OR gates with in a single IC package.

7.Defineaddressandword:

In a ROM, each bit combination of the input variable is called on address. Each bitcombination that comes out of the output lines is called a word.

8.WhatarethetypesofROM.

1.MaskedROM.

2.ProgrammableReadonlyMemory

3.ErasableProgrammableReadonlymemory.

4.ElectricallyErasableProgrammableReadonlyMemory.

9. What is PAL? How does it differ from PLA?

- The PAL programmable array logic is a programmable logic device with a fixed OR array and a programmable AND array. Because only AND gates are programmable, the PAL is easier to program but is not as flexible as the PLA. It's differ from PLA contains both AND and OR arrays are programmable.

10. What is meant by memory expansion? Mention its limit.

- The memory expansion can be achieved in two ways
  - By expanding word size
  - By expanding memory capacity
- The limit is connecting more than once IC's.

11. What is access time and cycle time of a memory?

Access time:

- This is the maximum time from the start of the valid address of the read cycle to the time when valid data is available at the data output.

Cycle time:

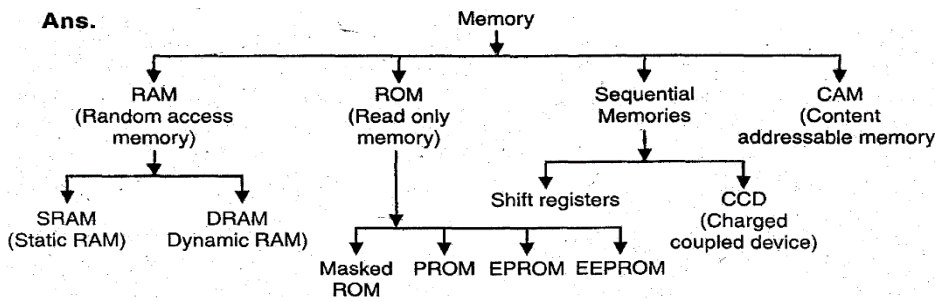
- This is the minimum amount of time for which the valid address must be present for writing a word in the memory.

12. What is the difference between PAL and PLA?

S. No	PAL	PLA
1.	Programmable array logic	Programmable logic array
2.	Programmable AND array and fixed OR array.	Both AND and OR array are programmable.

13. How the memories are classified?

Ans.



14. What is programmable logic array? How it differs from ROM?

In some cases the number of don't care conditions is excessive, it is more economical to use a second type of LSI component called a PLA .A PLA is similar to a RO Min concept; however it does not provide full decoding of the variables and does not generates all the minterm as in the ROM.

15.Whatisfieldprogrammablelogicarray?

The second type of PLA is called a field programmable logic array. The user by means of certain recommended procedures can program the EPLA.

16.DefinePLD.

ProgrammableLogicDevicesconsistofalargearrayofANDgatesandORgates that Can be programmed to achieve specific logic functions.

17.GivetheclassificationofPLDs.

PLD s are classified as PROM (Programmable Read Only Memory),Programmable Logic Array(PLA),Programmable Array Logic(PAL),and Generic Array Logic(GAL)

18.DefinePROM.

PROM is Programmable Read Only Memory. It consists of a set of fixed AND gates Connected to a decoder and a programmable OR array.

19.DefinePLA.

PLA is Programmable Logic Array(PLA).The PLA is a PLD that consists of a Programmable AND array and a programmable OR array.

20.DefinePAL.

PAL is Programmable Array Logic. PAL consists of a programmable AND array and a fixed OR array with output logic.

21.WhywasPALdeveloped?

ItisaPLDthatwasdevelopedtoovercomecertaindisadvantagesofPLA,such as longer delays due to additional fusible links that result from using two programmable arrays And more circuit complexity.

22.Definebit,byteandword.

The smallest unit of binary data is bit. Data are handled in a8bitunitcalled byte. A complete unit of information is called a word which consists of one or more bytes.

23.What is Read and Write operation?

TheWriteoperationstoresdataintoaspecifiedaddressintothememoryand the Read Operation takes data out of as specified address in the memory.

24.DefineROM.

ROM is a type of memory in which data a rest or permanently or semi permanently. Data can be read from a ROM, but there is no write operation.

25.DefineRAM.

RAM is Random Access Memory. It is a random access read/write memory. The data Can be read or written into from any selected address in any sequence.

26.DefineCachememory.

Itisarelativelysmall,high-speedmemorythatcanstorethemostrecentlyused instructions or data from larger but slower main memory.

27.Givethefeatureofflashmemory.

Theidealmemoryhashighstoragecapacity,non-volatility;in-systemreadand write Capability,comparativelyfastoperation.Thetraditionalmemorytechnologies suchasROM,PROM,EEPROMindividuallyexhibitsoneofthesecharacteristics, but no single technology has all of them except the flash memory.

28.WhatareFlashmemories?

They are high density read/write memories that are non-volatile, which means data can be stored indefinitely without power.

29.WhatisaFIFOmemory?

The term FIFO refers to the basic operation of this type of memory in which the first data bit written in to the memory is to first to be read out.

30.List basic types of programmable logic devices.

1.Readonlymemory

2.ProgrammablelogicArray

3.ProgrammableArrayLogic

31. Define address and word:

In a ROM, each bit combination of the input variable is called on address. Each bit Combination that comes out of the output lines is called a word.

32. What is programmable logic array? How it differs from ROM?

In some cases the number of don’t care conditions is excessive, it is more economical to use a second type of LSI component called a PLA. A PLA is similar to a RO Min concept; however it does not provide full decoding of the variables and does not generates all the min terms as in the ROM.

UNITV- SYNCHRONOUSAND AYNCHRONOUSSEQUENTIALCIRCUITS

1.Whatisfundamentalmodesequentialcircuit?

- Input variables changes if the circuit is stable
- Inputs are levels, not pulses
- Only one input can change at a given time

2.Whatispulsemodecircuit?

- Inputs are pulses
- Width of pulses are long for circuit to respond to the input
- Pulse width must not be so long that it is still present after the new state is reached

3.Whatisthesignificanceofstateassignment?

- In synchronouscircuits-stateassignmentsaremadewiththeobjectiveofcircuit
- ReductionAsynchronouscircuits-itsobjectiveistoavoidcriticalraces

4.Whendoes race condition occur?

- Two or more binary state variables change their value in response to the change in i/p Variable

5. What is non critical race?

- Final stable state does not depend on the order in which the state variable changes
- Race condition is not harmful

6. What is critical race?

- Final stable state depends on the order in which the state variable changes
- Race condition is harmful

10.Whatarethedifferenttechniquesusedinstateassignment?

- Shared row state assignment
- One hot state assignment

11.Whatarethestepsforthedesignofasynchronoussequential circuit?

- Construction of primitive flow table
- Reduction of flow table
- State assignment is made
- Realization of primitive flow table

12.Whatishazard?

- Unwanted switching transients

13.Whatisstatic1hazar?

- Outputgoesmomentarily0whenitshouldremainat1

13.Whatarestatic0hazards?

- Outputgoesmomentarily1whenitshouldremainat0

14.Whatisdynamichazard?

- Outputchanges3ormoretimeswhenitchangesfrom1to0or0to1

15.Whatisthecauseforessentialhazards?

- Unequaldelaysalong2ormorepathfromsameinput

16.Whatisflowtable?

- State table of an synchronous sequential network

17.WhatisSMchart?

- Describes the behavior of a state machine
- Used in hardware design of digital systems

18.WhataretheadvantagesofSMchart?

- Easy to understand the operation
- East to convert to several equivalent forms

20.Whatiscombinationalcircuit?

- Output depends on the given input. It has no storage element.

21.Whatisstateequivalencetheorem?

- Two states SA and SB, are equivalent if and only if for every possible inputX sequence, the outputs are the same and then ext states are equivalent i.e.,ifSA(t+1)= SB(t+1)and ZA=ZB then SA=SB.

22.Whatdoyoumeanbydistinguishingsequences?

Twostates,SAandSBofsequentialmachinearedistinguishableifandonlyif their existsatleastonefiniteinputsequence.Which,whenappliedtosequential machine causes differentoutputsequencesdependingonwhetherSAorSBistheinitialstate.

23.Definemergergraph.

Themergergraphisdefinedasfollows.Itcontainsthesamenumberofvertices as the statetablecontainsstates.Alinedrawnbetweenthetwostateverticesindicates each compatiblestatepair.Ittwostatesareincompatiblenoconnectinglineisdrawn.

24.Defineincompatibility

The states are said to be in compatible if no line is drawn in between them. If implied states are incompatible, they are crossed & the corresponding line is ignored

25.Explain the procedure for state minimization.

1.Partitionthestatesintosubsetssuchthatallstatesinthesamesubsetsare1 equivalent.

2.Partitionthestatesintosubsetssuchthatallstatesinthesamesubsetsare2 equivalent.

3.Partitionthestatesintosubsetssuchthatallstatesinthesamesubsetsare3 equivalent.

26.Defineclosedcovering.

ASetofcompatiblesissaidtobeclosedif,foreverycompatiblecontainedinthe set,allitsimpliedcompatiblesarealsocontainedintheset.Aclosedsetof compatibles,whichcontainsallthestatesofM,iscalledaclosedcovering.

27.Definestatetable.

For the design of sequential counters we have to relate present states and next states. The table, which represents the relationship between present states and next states, is called state table.

28.Definetotalstate.

Thecombinationoflevelsignalsthatappearattheinputsandtheoutputsofthe delays define what is called the total state of the circuit.

29.Whatarethestepsforthedesignofasynchronoussequential circuit?

1.Constructionofaprimitiveflowtablefromtheproblemstatement.

2.Primitiveflowtableisreducedbyeliminatingredundantstatesusingthestate reduction

3.Stateassignmentismade

4.Theprimitiveflowtableisrealizedusingappropriatelogicelements.

30.Defineprimitiveflowtable:

Itisdefinedasaflowtablewhichhasexactlyonestablestateforeachrowin thetable.Thedesignprocessbeginswiththeconstructionofprimitiveflow table.

31.What are the types of asynchronous circuits?

1.Fundamentalmodecircuits

2.Pulsemodecircuits

32.What are races?

When2ormorebinarystatevariableschangetheirvalueinresponsetoa change in an input variable, race condition occurs in an asynchronous sequential circuit. Incase of unequal delays ,a race condition may cause the state variables to change in an unpredictable manner.

33.Definen on critical race.

Ifthefinalstablestatethatthecircuitreachesdoesnotdependontheorderin which the state variable changes, the race condition are no harmful and it is called an on critical race.

34.Define critical race?

If the final stable state depends on the order in which the state variable changes ,the race condition is harmful and it is called a critical race.

35.What is a cycle?

Acycleoccurswhenanasynchronouscircuitmakesatransitionthroughaseries ofunstablestates.Ifacycledoesnotcontainastablestate, thecircuitwillgo from one unstable to stable to another ,until the inputs are changed.

36.List the different techniques used for state assignment.

1.Sharedrowstateassignment

2.Onehotstateassignment.

37.Write a short note on fundamental mode asynchronous circuit.

Fundamentalmodecircuitassumesthat.Theinputvariableschangeonlywhen the circuit is stable. Only one input variable can change at a given time and inputs are levels and not pulses.

38. Write a short note on pulse mode circuit.

Pulsemodecircuitassumesthattheinputvariablesarepulsesinsteadoflevel. Thewidthofthepulsesislongenoughforthecircuittorespondtotheinputand thepulsewidthmustnotbesolongthatitisstillpresentafterthenewstateis reached.

39.Definesecondaryvariables.

Thedelayelementsprovideashorttermmemoryforthesequentialcircuit.The presentstateandnextstatevariablesinasynchronoussequentialcircuitsare called secondary variables.

40.Defineflowtableinasynchronoussequentialcircuit.

Inasynchronoussequentialcircuitstatetableisknownasflowtablebecauseof thebehaviouroftheasynchronoussequentialcircuit.Thestagechangesoccurin independent of a clock ,based on the logic propagation delay, and cause the states to flow from one to another.

41.Whatis pulse mode asynchronous machine?

A pulse mode asynchronous machine has two inputs. If produces an output whenevertwo consecutive pulses occur on one input line only. The output remains at 1untilapulsehasoccurredontheotherinputline.Writedownthestatetablefor the machine.

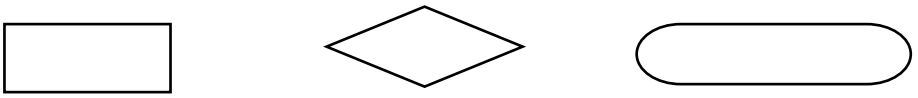
42.Whatisfundamentalmode?

Atransitionfromonestablestatetoanotheroccursonlyinresponsetoachange intheinputstate.Afterachangeinoneinputhasoccurred,nootherchangein anyinputoccursuntilthecircuitentersastablestate.Suchamodeofoperation is referred to as fundamental mode.

43.Write short note on one hot state assignment.

The one hot state assignment is another method for finding a race free state assignment.Inthismethod, onlyonevariableisactiveorhotforeachrowinthe originalflowtable, ie, itrequiresonestatevariableforeachrowoftheflow table.Additionalrowareintroducedtoprovidesinglevariablechangesbetween internal state transitions.

44. What are the basic building blocks of an algorithmic state machine chart?



State box Decision box Output box

PART B

UNIT 1

1.State and prove the postulates, theorems of Boolean algebra.

2.Use QM method to simply the Boolean expression(x1,x2,x3,x4,x5)= ∑(0,1,4,5,16,17,21,25,29) (NOV'2010)

3.UseQuineMcClusky method to obtain the minimal sum for the following function. F(X1X2X3X4)

= ∑ (0, 1, 3, 6, 7, 14, 15) (April 2003)

4.Simplify the function using Karnaugh map.

(i) F (ABCD) = ∑ (0, 1, 2, 4, 5, 7, 11, 15) (8mark)

(ii) F (WXYZ) = ∑ (2, 3, 10, 11, 12, 13, 14, 15) (8mark) (April 2003)

4. (i) State and prove demorgan's theorem and expand the function

F = (((A □ B)C □ CD)

(ii) Simplify the following switching function using karnaugh map,

F(A,B,C,D) = ∑ (0,5,7,8,9,10,11,14,15) + Φ (1,4,13) (10 mark)

5..i) Simplify the following Boolean function using 4 variable map F(w,x,y,z)= (2,3,10,11,12,13,14,15)

ii)Draw a NAND logic diagram that implements the complement of the following function

F(A,B,C,D)= ∑(0,1,2,3,4,8,9,12) (8mark)

6.Simplify the Boolean function using K-map and tabular methods. Compare the methods. F (A, B, C, D) =∑m(4,5,6,7,8) d (A, B, C, D) = ∑m(11,12,13,14,15).

7.Implement using only NAND gates

(i) Express the function f(x, y, z) =

(ii) Express the following function as the minimal sum of products,

using a K-map F (a,b,c,d) =∑m(0,2,4,5,6,8,10,15) + ∑Φ(7,13,14) (12 marks)

8.Implement the following with either NAND gate or NOR gate gates. Use only 4 gates. Only the normal inputs are available.

(i) d = WYZ (8mark)

(ii) F = W XZ □ WYZ □ X □ WX Y Z

UNIT 2

1. Designa BCD to Graycode converter. Usedon't cares

2. Design a halfadder and full adder circuits .

3. Design a half subractor and design a subractor

4. Designa4-bitbinaryto BCD code converter.

5. Construct a 4-bitbinarytograycodeconvertercircuitand discuss its operation.

6. Design a combinational circuit to convert Excess-3 code to BCD code.

7. i) Design an 8X1 MUX usingonly2X1 MUX (8)

ii) Design a circuit to carryout both addition and subtraction (8)

8. Design a BCD adder to add two BCD digits

9. Design a combinational circuit that accepts 3 bit binary number and converts it to excess 3 code.

10. Design a circuit to compare two four bit numbers

11. Design a Gray to BCD code converter

12. Design a combinational circuit to convert BCD code to Excess-3 code

13. Design a combinational logic circuit to compare two 2-bit binary numbers A and B and to generate the outputs A<B,A=B and A>B

14.(i)Realize F(w,x,y,z)=S(1,4,6,7,8,9,10,15)using4 to 1 Mux (8mark)
(ii) Design a binary multiplier circuit

15. (i)Design an 8x1 MUXusingonly2x1 MUX
(ii) Design a circuit to carryout both addition and subtraction
16. Design and implement the conversion circuit for BCD to Excess 3 code (16)
17. (i).Design a combinational circuit that generates the 9's complement of a BCD digit (8)
(ii) Explain the operation of carry look ahead adder with neat diagram.
18. (i) Define fan-in, fan–out and Noise margin (6) NOV'2010
(ii) Design combinational system that produces the product of 2 binary number A=(A1,A0) X B=(B2,B1,B0) (10)

UNIT 3

1. i) Provide the characteristic table, characteristic equation and excitation table of D flip flop and JK flip flop (6)

ii) Explain the operation universal shift register with neat block diagram (8) Nov'2010

3. With a neat state diagram and logic diagram , design and explain the sequence of states of BCD counter (16**)**

3. Draw the circuit and explain the working operation of JK Master Slave flip-flop

4. Explain the various steps in the analysis of synchronous sequential circuits with suitable example.

5. Using D flip-flops, design a synchronous counter which counts in thesequence000, 001, 010,011, 100, 101, 110, 111, 000

6. Using JK flip-flops, design asynchronous counter which counts in thesequence000, 111, 101,110, 001, 010, 000……

7. Design a binary counter using T flip-flops to count pulses in the following sequence

(i)000, 001, 010, 011, 100, 101, 110, 111, 000

(ii) 000, 100, 111, 010, 011, 000 (8)

8. Explain the functional operation of a 4 bit binary ripple counter with its logical diagram

9. Explain the working of Master-slave flip-flop.

10. i) Drawa4 bit serial in serial out shift register and draw its waveforms. (8)

ii). Draw a4 bit serial in parallel out(SIPO) and explain its operation. (8)

11. Explain the operation of BCD counter.

12. Design an Asynchronous BCD down counter usingJ-K flip=flop and verify its operation.

13. Design asynchronous mod-8 down counter and implement it.

14. Design and explain the working of a up-down ripple counter

15. (i)Explain the operation of D type edge triggered flip flop.

(ii) How can a D flip flop converted into aT flip flop.

16. Using JK flip-flops, design asynchronous counter which counts in thesequence2,6,1,7,5,4and repeat.

17. Design a Mod 5 Asynchronous counter draws the waveforms. (8marks)

18. Using RSflip-flops, design a Parallel counter which counts in thesequence000, 111, 101, 110,001, 010, 000……

19. .i) Draw the logic diagram for a master–slave JK flip flop and explain. (8)

ii) Draw the four bit Johnson counter and explain the operation

20. Draw and explain the logic diagram of up/down counter

UNIT 4

1. Explain the basic structure of 256x4 static RAM with neat sketch (8)
2. Write a note on (i) MOSFET RAM cell (8) (ii) Dynamic RAM cell (8)
3. i) Explain read and write operation of memory with timing wave forms. (8)

ii) Write a note on RAM.

4. i) Draw a PLA circuit to implement the functions F1=A'B+AC'+A'BC ; F2=(AC+AB+BC)'

ii) Write a note on FPGA. (8) (Nov 2010)

5. A combinational circuit is defined by the functions

F1= ∑m(3,5,7)

F2=∑m(4,5,7)

Implement the circuit with a PLA having3 inputs, 3 product terms and two outputs.

6.Implement binary to excess 3 code converter using ROM. (16)

7.Tabulatethe PAL programming table for the four Boolean functions listed below.

A(x,y, z) =∑(1, 2, 4, 6), B(x,y, z) =∑(0, 1,6, 7)

C(x,y, z) =∑(2, 6), D(x,y, z) =∑(1, 2,3, 5, 7) (16)

8. A combinational circuit is defined by the functions (8)

F2(A,B,C)=Σ(0,2,4,7)implement the circuit with a PLA.

9. A combinational circuit is described by the functions F1=∑m(3,4,5,7,10,14,15),F2=∑m(1,5,7,11,15)Implement the circuit with a PLAhaving4inputs,6 product terms and two outputs

10.Acombinational circuit is defined by the functions

F1= ∑m(3,5,7) F2= ∑m(4,5,7)

Implement the circuit with a PLA having3 inputs, 3 product terms and two outputs.

11.Acombinational circuit is defined by the functions

F1= ∑m(1,3,5) F2= ∑m(5,6,7)

Implement the circuit with a PLA having 3 inputs, 3 product terms and two outputs.

UNIT 5

1. i)Give examples for critical race and cycle and explain

ii) Describe the hazards with neat circuit diagram.

4. Give the hazard free realization for the following functions. f(a, b, c, d) = □ m (0, 2, 6, 7, 8, 10, 12)

3. Design an asynchronous sequential circuit that has two inputs X2 and X1 and one output z. When x1 = 0, the output Z is 0. The first change in X2 that occurs while X1 is 1 will cause output Z to be 1. The output Z will remain 1 until X1 returns to zero. (16)

4. An asynchronous sequential circuit has two internal states and one output. The excitation and output function describing the circuit are as follows.

5. i)Give hazard-free realization for the following Boolean function F(A,B,C,D)=Σm(1,3,6,7,13,15)

ii) Summarize the design procedure for asynchronous sequential circuit.

6.An asynchronous sequential circuit is described by the following excitation and output function.

Y=X1X2+(X1+X2)Y

i) Draw the logic diagram

ii) Derive the transition table and output map iii) Describe the behavior of the circuit.

7. An asynchronous network has two inputs and one output. The input sequence X1X2 =00, 01,11causes the output to become 1.The next input change then causes the output to return to 0. No other input sequence will produce a 1 output. Construct the state diagram using primitive flow table (16)

8.a)Design a circuit with inputs A and B to give an output Z equal to 1 when AB=11 but only if A becomes 1 before B, by drawing total state Diagram, primitive flow table and output map in which transient state is Included.

b) Design a circuit with primary inputs A and B to give an output Z equal to 1 When A becomes 1 if B is already 1.Once Z=1 it will remain so until A goes to c) Draw waveform diagram, total state diagram, primitive flow table for designing the circuit

9. An asynchronous circuit described by the following excitation and output function Y=X1.X2+(X1+X2).Y Z=Y

Draw the logic diagram of the circuit. Derive the transition table and output map. Describe the behavior of the circuit

10. Design a asynchronous sequential circuit with 2 inputs X and Y and with one output Z whenever Y is 1, input X is transferred to Z.When Y is 0,the output does not change for any change in X. use SR latch for implementation of the circuit

11. What is a merger graph .How it is used to reduce states in the incompletely specified table

12. What are the problems in asynchronous circuits and what are essential hazards and static hazards how it can be eliminated

13. Design T flip flop from logic gates.

14..Give the hazard free realization for the following functions.

(i) NAND gates

(ii) NOR gates

f(a, b, c, d) = □ m (1,5,7,14,15)

16. Design a sequence Detector circuit with a single input line and a single output line. Whenever the input consists of the sequence 101 , the output should be 1. For example, if the input is 00110101…,then the output is 00000101… in other words,over lapping sequences are allowed. Use any type of flip flop. (16)

16.(i) .Give the hazard free realization for the following functions.

f(a, b, c, d) = □ m (1,3,6,7,13,15) (8marks)

(ii) Summarize the design procedure for asynchronous sequential circuit. (8marks)

17. An asynchronous circuit described by the following excitation and output function X=(Y1.Z1'W2) X + (Y1'Z1W2') S=X'

Draw the logic diagram of the circuit. Derive the transition table and output map. Describe the behavior of the circuit

18. Explain essential, static and dynamic Hazards in Digital circuit. Give the hazard free realization for thefollowing functions.

F(I,J,K,L) = □ m (1,3,4,5,6,7,9,11,15)

19. Design an asynchronous circuit using JK FF that will O/P only the first pulse received and will ignore any other pulses (16)

20. i) Differentiate critical races from non-critical races. (6) NOV'2010

ii) Explain the steps involved in the reduction of state table. (10)

Reg. No. : [ ]

Question Paper Code : 21353

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2013.

Third Semester

Electronics and Communication Engineering

EC 2203 / EC 34 / 10144 EC 304 / 080290010 – DIGITAL ELECTRONICS

(Regulation 2008 / 2010)
(Common to PTEC 2203 – Digital Electronics for Third Semester B.E. (Part-Time) Electronics and Communication Engineering – Regulation 2009)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. State De Morgan's theorem.

2. What are Don't care terms?

3. Design a Half subtractor using basic gates.

4. Draw the logic diagram of a 4 line to 1 line Multiplexer.

5. Convert D flipflop to T flipflop.

6. How many flipflops are required to build a binary counter that counts from 0 to 1023?

7. What are the different types of programmable logic devices?

8. Distinguish between PLA and PAL.

9. What are Hazards?

10. Distinguish between a flowchart and an ASM chart.

PART B — (5 × 16 = 80 marks)

11. (a) Minimize the given switching function using Quine – Mcclusky method.

$f(x_1, x_2, x_3, x_4) = \sum(0, 5, 7, 8, 9, 10, 11, 14, 15)$. (16)

Or

(b) Simplify the given Boolean function into

(i) Sum of products form (8)

(ii) Product of sum form and implement if using basic gates. (8)

F (A, B, C, D) = $\sum$ (0, 1, 2, 5, 8, 9, 10).

12. (a) Design a BCD adder and explain its working with necessary circuit diagram. (16)

Or

(b) Design a 4 bit magnitude comparator and draw the circuit. (16)

13. (a) Design a counter to count the sequence 0, 1, 2, 4, 5, 6 using SRFFs. (16)

Or

(b) Design a 4 bit Asynchronous Ripple counter and explain its operation with timing diagrams. (16)

14. (a) Design using PAL the following Boolean functions.

W (A, B, C, D) = $\sum$ (2, 12, 13)

X (A, B, C, D) = $\sum$ (7, 8, 9, 10, 11, 12, 13, 14, 15)

Y (A, B, C, D) = $\sum$ (0, 2, 3, 4, 5, 6, 7, 8, 10, 11, 15)

Z (A, B, C, D) = $\sum$ (1, 2, 8, 12, 13). (16)

Or

(b) Design and explain a 32 × 8 ROM. (16)

15. (a) Design a hazard-free asynchronous circuit that changes state whenever the input goes from logic 1 to logic 0. (16)

Or

(b) (i) Design a full adder using two half adders by writing verilog program. (10)

(ii) Write Explanatory notes on Algorithmic state machines. (6)

Question Paper Code : 71444

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Electronics and Communication Engineering

EC 2203/EC 34/080290010/10144 EC 304 — DIGITAL ELECTRONICS

(Regulation 2008/2010)

(Common to PTEC 2203 – Digital Electronics for B.E. (Part-Time) Third Semester – Electronics and Communication Engineering Regulation 2009)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Define 'min term' and 'max term'.

2. Write a note on tristate gates.

3. Give the logic expressions for sum and carry in full adder circuit.

4. Give examples for combinational circuit (any four).

5. Realize T FF and JK FF.

6. Draw the circuit diagram of a 3 bit Ring counter.

7. Compare static and dynamic RAM cell (any two).

8. $Y = A\overline{B} + \overline{A}$. Implement using ROM.

9. Differentiate flow chart and ASM chart.

10. List the problems that arise in asynchronous circuits.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Simplify $T(x,y,z)=(x+y)\left[\overline{\overline{x}(\overline{y}+\overline{z})}\right]+\overline{x}\,\overline{y}+\overline{x}\,\overline{z}$. (6)

(ii) Simplify the Boolean function and draw the logic diagram $f(w,x,y,z)=\Sigma(0,1,2,4,5,6,8,9,12,13,14)$. (10)

Or

(b) (i) Realize AND, OR and NOT gates using NAND gate. (6)

(ii) Using tabulation method simplify $F(A,B,C,D,E)=\Sigma(0,1,4,5,16,17,21,25,29)$. (10)

12. (a) Design a combinational circuit that converts 4 bit Gray Code to a 4 bit binary number. Implement the circuit.

Or

(b) Detail the following :

(i) BCD adder. (8)

(ii) Magnitude comparator. (8)

13. (a) (i) Describe a JK FF with its characteristic table and characteristic equation. (6)

(ii) With a neat sketch describe a 3 bit synchronous up/down counter. Draw the timing waveform. (10)

Or

(b) Design a sequential circuit with two D FFs A and B and one input x. When $x=0$, the state of the circuit remains the same. When $x=1$, the circuit gas through the state transitions from $00-01-11-10-00-01\ldots$

14. (a) (i) List the steps involved in memory read and memory write operations. (10)

(ii) Give an account for classification of memories. (6)

Or

(b) Explain the structure of PAL and PLA. How a combinational logic function is implemented in PAL and PLA? Explain with an example for each. (16)

15. (a) (i) Write the VERILOG code for full adder and JK FF. (8)

(ii) Explain the different types of hazards. Design a hazard free circuit for $y=x_1x_2+x_2'x_3$. (8)

Or

(b) With ASM chart design a binary multiplier. (16)

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Question Paper Code : 21444

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Electronics and Communication Engineering

EC 2203/EC 34/080290010/10144 EC 304 – DIGITAL ELECTRONICS

(Regulations 2008/2010)

(Common to PTEC 2203 – Digital Electronics for B.E. (Part-Time) Third Semester – Electronics and Communication Engineering Regulations 2009)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Simplify the given Boolean expression using De Morgan's theorem $F = \overline{A\left(\overline{B+\overline{C}}\right)D}$.

2. Design a 3 input CMOS NAND gate.

3. Draw a Half adder using NAND gates.

4. Draw the logic diagram of 4:1 multiplexer.

5. What is the advantage of using master–slave JK flipflops?

6. Design a 3-bit ring counter.

7. Draw the logic diagram of bipolar RAM cell.

8. Differentiate static and dynamic RAM.

9. List the types of hazards that exist in asynchronous sequential circuits.

10. Model a D-Flipflop using verilog.

PART B — (5 × 16 = 80 marks)

11. (a) Simplify the given Boolean function using Quine McCluskey method $F = \sum m(0, 1, 2, 4, 5, 6, 8, 9, 12, 13, 14)$. Realise the simplified function using logic gates. (16)

Or

(b) (i) Determine the Boolean expression for the logic circuit shown in Fig. 11(b)(i). Simplify the Boolean expression. (8)

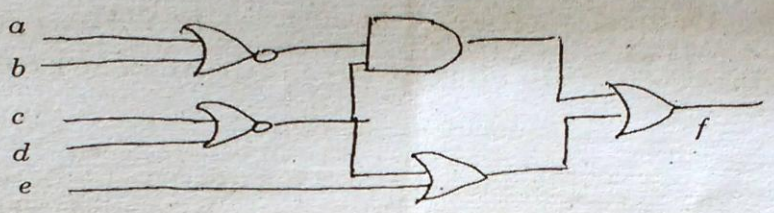

Fig. 11 (b) (i)

(ii) Using K-map method, simplify the given Boolean function and obtain minimum POS expression.

$X = \sum m(0,2,3,6,7) + \sum d(8,10,11,15)$. (8)

12. (a) Design a BCD adder and explain its operation. (16)

Or

(b) Design a BCD to excess 3 code converter. (16)

13. (a) (i) Design a 4 bit asynchronous up/down counter using JK flipflops. (8)

(ii) Design a mod-10 synchronous counter using D-flipflops. (8)

Or

(b) (i) Draw the logic diagram of a 4-bit universal shift register and explain its operation. (10)

(ii) Design a 4 bit serial adder. (6)

14. (a) Explain in detail about memory decoding and memory expansion. (16)

Or

(b) How the programmable logic devices are classified? Explain each one of them in detail.

15. (a) Analyse the given synchronous sequential circuit shown in Fig. 15(a). (16)

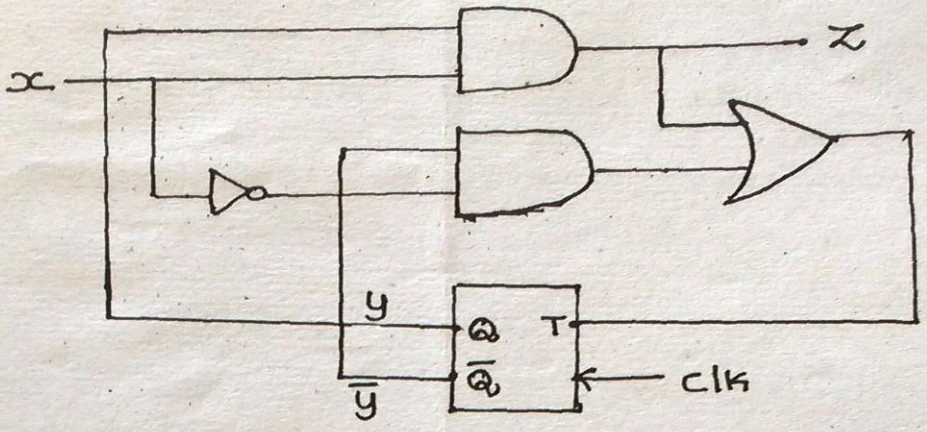

Fig. 15(a)

Or

(b) Using verilog model the given circuits.

(i) 3:8 Decoder. (8)

(ii) 2 bit up/down synchronous counter. (8)

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Question Paper Code : 57281

B.E./B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Electronics and Communication Engineering

EC 6302 – DIGITAL ELECTRONICS

(Common to Mechatronics Engineering and Robotics and Automation Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Prove the Boolean theorems : (a) $x + x = x$

   (b) $x + xy = x$

2. Define Noise margin.

3. Write the design procedure of combinational circuit.

4. Draw the combinational circuit that converts 2 coded inputs into 4 coded outputs.

5. Differentiate synchronous and asynchronous sequential circuits.

6. Give the truth table of transparent latch.

7. Give the classification of programmable logic devices.

8. How the bipolar RAM cell is different from MOSFET RAM cell ?

9. What is Hazard ? Give its types.

10. Define critical race and give the methods for critical-race free state assignment.

PART – B (5 × 16 = 80 marks)

11. (a) Simplify the following Boolean function F, using Quine Mccluskey method and verify the result using K-map $F(A, B, C, D) = \Sigma (0, 2, 3, 5, 7, 9, 11, 13, 14)$ **(16)**

OR

(b) (i) Draw and explain Tri-state TTL inverter circuit diagram with its operation. **(10)**

(ii) Implement the following function using NAND and inverter gates. **(6)**

$F = AB + A'B' + B'C$

12. (a) (i) Design a 4-bit magnitude comparator with 3 outputs : $A > B$, $A = B$, $A < B$. **(8)**

(ii) Design a 4 bit binary to gray code converter. **(8)**

OR

(b) (i) Implement the following Boolean function using 8 × 1 Multiplexers.

$F (A, B, C, D) = \Sigma (1, 3, 4, 11, 12, 13, 14, 15)$ **(8)**

(ii) Explain the concept of carry look ahead adder with neat logic diagram. **(8)**

13. (a) Design a 3-bit synchronous counter using D-flip flop. **(16)**

OR

(b) (i) Draw and explain the 4-bit SISO, SIPO, PISO and PIPO shift register with its waveforms. **(12)**

(ii) Realize D flip-flop using SR flip-flop. **(4)**

14. (a) (i) Implement the following function using PLA. **(12)**

F1 $(x, y, z) = \Sigma m (1, 2, 4, 6)$

F2 $(x, y, z) = \Sigma m (0, 1, 6, 7)$

F3 $(x, y, z) = \Sigma m (2, 6)$

(ii) Write short notes on FPGA. **(4)**

OR

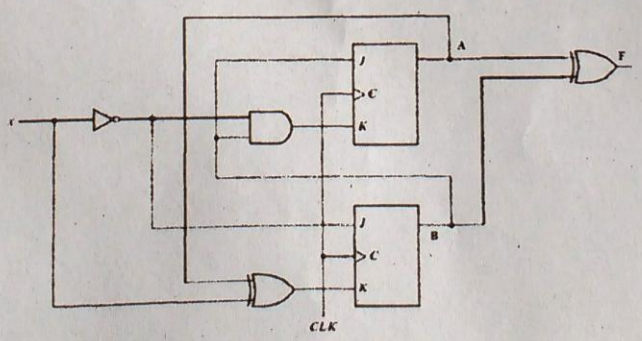
(b) (i) Explain memory READ and WRITE operation with neat timing diagram. **(8)**

(ii) Explain the organization of ROM with relevant diagrams. **(8)**

15. (a) Design an asynchronous sequential circuit with two inputs X_1 and X_2 and with one output Z. When X_1 is 0, the output Z is 0. The first change in X_2 that occurs while X_1 is 1 will cause output Z to be 1. The output Z will remain 1 until X_1 returns to 0. **(16)**

OR

(b) Construct the transition table, state table and state diagram for the more sequential circuit given below. **(16)**



Reg. No. :

Question Paper Code : 80333

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Electronics and Communication Engineering

EC 6302 — DIGITAL ELECTRONICS

(Common to Mechatronics Engineering and Robotics and Automation Engineering)

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Simplify the following expression $X \cdot Y + X(Y + Z) + Y(Y + Z)$.

2. Why totem pole outputs cannot be connected together.

3. Write about the design procedure for combinational circuits.

4. Draw the logic diagram and truth table of Full adder.

5. Define race around condition in flip flop.

6. Draw D-latch with truth table.

7. Briefly explain about EEPROM.

8. What is programmable logic array? How it differs from ROM?

9. Define Critical race and Non Critical race.

10. What is hazard and give it types?

PART B — (5 × 13 = 65 marks)

11. (a) (i) Find the MSOP representation for $F(A, B, C, D, E) = m(1, 4, 6, 10, 20, 22, 24, 26) + d(0, 11, 16, 27)$ using K-Map method. Draw the circuit of the minimal expression using only NAND gates. (7)

(ii) With neat circuit diagram, explain the function of 3-input TTL NAND gate. (6)

Or

(b) What are the advantages of using tabulation method? Determine the Minimal sum of products for the Boolean expression $F = \sum(1, 2, 3, 7, 8, 9, 10, 11, 14, 15)$ using tabulation method. (13)

12. (a) (i) Design and explain 1 of 8 demultiplexer. (8)

(ii) What is parity checker? (5)

Or

(b) Describe the operation of 3-bit magnitude comparator. (13)

13. (a) (i) Explain the operation of JK flip-flop with neat diagram. (6)

(ii) Explain the operation of Serial- in-Serial-out shift register. (7)

Or

(b) Design synchronous MOD-6 counter. (13)

14. (a) Differentiate static and dynamic RAM. Draw the circuits of one cell of each and explain its working principle. (13)

Or

(b) Write short notes on :

(i) PAL

(ii) FPGA. (13)

15. (a) Explain the steps involved in the design of asynchronous sequential circuit.

Or

(b) Design an asynchronous circuit that will output only the second pulse received and ignore any other pulse. (13)

PART C — (1 × 15 = 15 marks)

16. (a) Design a synchronous up/down counter. (15)

Or

(b) Design an even parity generator that generates an even parity bit for every input string of 3-bits. (15)

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EC6303 SIGNALS AND SYSTEMS L T P C
3 1 0 4

UNIT I CLASSIFICATION OF SIGNALS AND SYSTEMS 9
Continuous time signals (CT signals) - Discrete time signals (DT signals) - Step, Ramp, Pulse, Impulse, Sinusoidal, Exponential, Classification of CT and DT signals - Periodic & Aperiodic signals, Deterministic & Random signals, Energy & Power signals - CT systems and DT systems- Classification of systems – Static & Dynamic, Linear & Nonlinear, Time-variant & Time-invariant, Causal & Noncausal, Stable & Unstable.

UNIT II ANALYSIS OF CONTINUOUS TIME SIGNALS 9
Fourier series analysis-spectrum of Continuous Time (CT) signals- Fourier and Laplace Transforms in CT Signal Analysis - Properties.

UNIT III LINEAR TIME INVARIANT- CONTINUOUS TIME SYSTEMS 9
Differential Equation-Block diagram representation-impulse response, convolution integrals- Fourier and Laplace transforms in Analysis of CT systems

UNIT IV ANALYSIS OF DISCRETE TIME SIGNALS 9
Baseband Sampling - DTFT – Properties of DTFT - Z Transform – Properties of Z Transform

UNIT V LINEAR TIME INVARIANT-DISCRETE TIME SYSTEMS 9
Difference Equations-Block diagram representation-Impulse response - Convolution sum- Discrete Fourier and Z Transform Analysis of Recursive & Non-Recursive systems

TOTAL (L:45+T:15): 60

TEXT BOOK:
1. Allan V.Oppenheim, S.Wilsky and S.H.Nawab, “Signals and Systems”, Pearson, 2007.

REFERENCES:
1. B. P. Lathi, “Principles of Linear Systems and Signals”, Second Edition, Oxford, 2009.
2. R.E.Zeimer, W.H.Tranter and R.D.Fannin, “Signals & Systems - Continuous and Discrete”, Pearson, 2007.
3. John Alan Stuller, “An Introduction to Signals and Systems”, Thomson, 2007.

UNIT I

1. **Define Signal.**

A signal is a function of one or more independent variables which contain some information.

Eg: Radio signal, TV signal, Telephone signal etc.

2. Define System.

A system is a set of elements or functional blocks that are connected together and produces an output in response to an input signal.

Eg: An audio amplifier, attenuator, TV set etc.

3. Define CT signals.

Continuous time signals are defined for all values of time. It is also called as an analog signal and is represented by x (t).

Eg: AC waveform, ECG etc.

4. Define DT signal.

Discrete time signals are defined at discrete instances of time. It is represented by x(n).

Eg: Amount deposited in a bank per month.

5. Give few examples for CT signals.

AC waveform, ECG, Temperature recorded over an interval of time etc.

6. Give few examples of DT signals.

Amount deposited in a bank per month,

7. Define unit step, ramp and delta functions for CT.

Unit step function is defined as

U (t)= 1 for t >= 0

0 otherwise

Unit ramp function is defined as

r(t)=t for t>=0

0 for t<0

Unit delta function is defined as

δ(t)= 1 for t=0

0 otherwise

8. State the relation between step, ramp and delta function (CT).

The relationship between unit step and unit delta function is

δ (t)= u(t)

The relationship between delta and unit ramp function is

δ(t).dt = r(t)

9. State the classification of CT signals.

The CT signals are classified as follows

(i) Periodic and non periodic signals

(ii) Even and odd signals

(iii) Energy and power signals

(iv) Deterministic and random signals.

10. Define deterministic and random signals.

A deterministic signal is one which can be completely represented by mathematical equation at any time. In a deterministic signal there is no uncertainty with respect to its value at any time.

Eg: x(t)=cos wt

x(n)=2πfn

A random signal is one which cannot be represented by any mathematical equation.

Eg: Noise generated in electronic components, transmission channels, cables etc.

11. Define power and energy signals.

The signal x(t) is said to be power signal, if and only if the normalized average power p is finite and non-zero.

ie. $0<p< 4$

A signal x(t) is said to be energy signal if and only if the total normalized energy is finite and non-zero.

ie. $0<E< 4$

13. Define odd and even signal.

A DT signal x(n) is said to be an even signal if x(-n)=x(n) and an odd signal if x(-n)=-x(n).

A CT signal is x(t) is said to be an even signal if x(t)=x(-t) and an odd signal if x(-t)=-x(t).

14. Define periodic and aperiodic signals.

A signal is said to be periodic signal if it repeats at equal intervals.

Aperiodic signals do not repeat at regular intervals.

A CT signal which satisfies the equation x(t)=x(t+T) is said to be periodic and a DT signal which satisfies the equation x(n)=x(n+N)is said to be periodic.

15. State the classification or characteristics of CT and DT systems.

The DT and CT systems are according to their characteristics as follows

(i). Linear and Non-Linear systems

(ii). Time invariant and Time varying systems.

(iii). Causal and Non causal systems.

(iv). Stable and unstable systems.

(v). Static and dynamic systems.

(vi). Inverse systems.

16. Define linear and non-linear systems.

A system is said to be linear if superposition theorem applies to that system. If it does not satisfy the superposition theorem, then it is said to be a nonlinear system.

17. Define Causal and non-Causal systems.

A system is said to be a causal if its output at anytime depends upon present and past inputs only.

A system is said to be non-causal system if its output depends upon future inputs also.

18. Define time invariant and time varying systems.

A system is time invariant if the time shift in the input signal results in corresponding time shift in the output.

A system which does not satisfy the above condition is time variant system.

19. Define stable and unstable systems.

When the system produces bounded output for bounded input, then the system is called bounded input, bounded output stable.

A system which does not satisfy the above condition is called a unstable system.

20. Define Static and Dynamic system.

A system is said to be static or memory less if its output depends upon the present input only.

The system is said to be dynamic with memory if its output depends upon the present and past input values.

PART-B

1. Discuss the classification of DT and CT signals with examples.
2. Discuss the classification of DT and CT systems with examples.
3. Problems on the properties & classifications of signals & systems
4. Find whether the following signals are periodic or not
    a. x(t)=2cos(10t+1)-sin(4t-1)
    b. x(t)=3cos4t+2sin pt
5. Check whether the following system is

Static or dynamic

Linear or non-linear

Causal or non-causal

Time invariant or variant a. y(n)=sgn[x(n]

6. For the systems represented by the following functions. Determine whether every system is (1) stable (2) Causal (3) linear (4) Shift invariant

   (i) T[x(n)]= ex(n)

   (ii) T[x(n)]=ax(n)+6

7. Determine whether the following systems are static or Dynamic, Linear or Nonlinear, Shift variant or Invariant, Causal or Non-causal, Stable or unstable.

   (i) y(t) = x(t+10) + x2(t)

   (ii) dy(t)/dt + 10 y(t) = x(t)

8. Explain about the properties of continuous time fourier series.

9. Find the fourier series coefficients of the given signal.

   x(t) = 1+ sin 2_ot + 2 cos 2_ot + cos (3_ot + _/3)

10. Determine the Fourier series coefficient of exponential representation of x(t)

    x(t) = 1, ItI

    = 0, T1< ItI < T/ 2

11. Find which of the following signal is energy or power signals.

    a. x(t)=e-3t u(t) b) x(t) = $e^{j(2t+1/4)}$ c) x(n)= cos(1/4n)

12. Explain the properties of Discrete time fourier series.

13. Find the cosine fourier series of an half wave rectified sine function.

14. Explain the classification of signals with examples.

UNIT-2

ANALYSIS OF CT SIGNALS

1. Define CT signal

Continuous time signals are defined for all values of time. It is also called as an analog signal and is represented by x (t).

Eg: AC waveform, ECG etc.

2. Compare double sided and single sided spectrums.

The methods of representing spectrums of positive as well as negative frequencies are called double sided spectrums.

The method of representing spectrums only in the positive frequencies is known as single sided spectrums.

3. Define Quadrature Fourier Series.

Consider x(t) be a periodic signal. The Fourier series can be written for this signal as follows

$$x(t)= a0+\sum_{n=1} a_n \cos wn + \sum_{n=1} b_n \sin wn$$

This is known as Quadrature Fourier Series.

4. Define polar Fourier Series.

$$X(t)= a_0 + \sum_{n=1} a_n \cos(wnt + \phi)$$

The above form of representing a signal is known as Polar Fourier series.

5. Define exponential Fourier series.

$$x(t)= \sum_{n=1} c_n e^{j2\pi t/N}$$

The method of representing a signal by the above form is known as exponential fourier series.

6. State Dirichlets conditions.

(i).The function x(t) should be single valued within the interval T_0 (ii). The function x (t) should have almost a finite number of discontinuities in the interval T_0 (iii). The function x(t) should have finite number of maxima and minima in the interval T_0 (iv). The function should have absolutely integrable.

7. State Parsevals power theorem.

Parsevals power theorem states that the total average power o f a periodic signal x(t) is equal to the sum of the average powers of its phasor components.

8. Define Fourier Transform.

Let x(t) be the signal which is the function of time t. The fourier transform of x(t) is given by

$$X(w)= X(t)e^{jwt} dt$$

9. State the conditions for the existence of fourier series.

(i). The function x(t) should be single valued in any finite time interval T

(ii). The function x(t) should have at most finite number of discontinuities in any finite time interval T.

(iii). The function x(t) should have finite number of maxima and minima in any time interval T.

(iv) The function x(t) should be absolutely integrable.

10. Find the Fourier transform of function x (t)= δ(t)

Ans: 1

11. State Rayleigh‘s energy theorem.

Rayleigh‘s energy theorem states that the energy of the sign al may be written in frequency domain as superposition of energies due to individual spectral frequencies of the signal.

12. Define Laplace transform.

Laplace transform is the another mathematical tool used for analysis of continuous time signals and systems. It is defined as

F(s) = $f(t)e^{st}\,dt$

13. Obtain the Laplace transform of ramp function.

Ans: 1/s 2

14. What are the methods for evaluating inverse Laplace transform?

The two methods for evaluating inverse laplace transform are

(i). By Partial fraction expansion method.

(ii). By convolution integral.

15. State initial value theorem.

If x(t)-----[L]------ --- X(s), then value of x(t)is given as, x(0+) = lim $_{t->0+}$ [SX(s)].

provided that the first derivative of x(t) should be laplace transformable.

16. State final value theorem.

If x(t) and X(s) are laplace transform pairs, then the final value of x(t) is given as ,

Lim t->4 x(t)= Lim s->0 [sX(s)]

17. State the convolution property of Fourier transform.

If x_1(t) and x_1(f) are fourier transform pairs and x_2(t) and x_2(f) are fourier transform pairs, then

□1 x_1(t)x $_2$(f- t)d t is fourier transform pair with X1(f)X2(f)

18.What is the relationship between Fourier transform and Laplace transform.

X(s)=X(jw) when s=jw

This states that laplace transform is same as fourier transform when s=jw.

19. Find the fourier transform of sign function.

Ans: 2/j

20. Find out the laplace transform of f(t)=e ^{at}

Ans: 1/(s-a)

PART- B

1. State and prove properties of Fourier transform.
2. State the properties of Fourier series.
3. State the properties of Laplace transform.
4. Problems on fourier series, Fourier transform and Laplace transform.
   a. Find the fourier series of of the periodic signal x(t)=t 0<=t<=1
   b. Find the fourier transform of x(t)=$e^{u(t)}$
   c. Find the laplace transform of the signal x(t)= e -at u(t)+ e -bt u(-t)
5. State and prove Parsevals power theorem and Rayleigh‘s energy theorem.
6. Determine the inverse Laplace of the following functions.

   1)1/s(s+1) 2) 3s2 +8s+6 (s+2)(s2+2s+1)

7. Explain about the classifications of continuous time system.

8. A system is described by the differential equation. $d^2y(t)/dt^2$+3dy(t)/dt+2y(t)=dx(t)/dt if y(0) =2;dy(0)/dt = 1 and x(t)=e-t u(t) Use laplace transform to determine the response of the system to a unit step input applied at t=0.

9. Obtain the transfer function of the system when y(t) = e-t-2 e-2t+ e-3t and x(t)= e-0.5t Bring the equivalence between Laplace transform and Fourier transform.

10. Explain the properties of laplace transform

11. Find the impulse and step response of the following systems H(s) = 10/s2+6s+10

12. For the transfer function H(s) = s+10/ s2+3s+2 find the response due to input x(t) = sin2(t) u(t)

13. Find the fourier transform of triangular pulse (10) x(t) = _(t/m) ={1-2|t|/m |t| 0 otherwise

14. The input and output of a causal LTI system are related by the differential equation.

15. d2y(t)/dt2+6dy(t)/dt+8y(t)=2x(t) i) Find the impulse response of the system. ii) What is the response of this system if x(t) = t e-2t u(t)

16. Consider a causal LTI system with frequency response. For a particular input x(t) this system is y(t)= e-2t u(t) - e-3t u(t)

UNIT III
LTI- CT SYSTEMS

1. Define LTI-CT systems.

In a continuous time system if the time shift in the input signal results in the corresponding time shift in the output, then it is called the LTI-CT system

2. What are the tools used for analysis of LTI-CT systems?

The tools used for the analysis of the LTI-CT system are

Fourier transform

Laplace transform

3. Define convolution integral.

The convolution of two signals is given by

y (t) = x(t)*h(t)

Where

x (t)*h(t)= $\int x(t)h(t-T)dt$

This is known as convolution integral.

4. List the properties of convolution integral.

a. commutative property
b. distributive property
c. associative property
d. shift property
e. convolution with an impulse
f. width property

5. State commutative property of convolution.

The commutative property of convolution states that

x1(t)*x2(t)=x 2(t)*x1(t)

6. State the associative property of convolution.

Associative property o f convolution states that

x1(t)*[x2(t)*x3(t)]=[x1(t)*x2(t)] *x 3

7. State distributive property of convolution.

The distributive property states that

x1(t)*[x2(t)+x 3(t)]=x1(t)*x2(t)+x1(t)*x3(t)

8. When the LTI-CT system is said to be dynamic?

In LTI CT system, the system is said to be dynamic if the present output depends only on the present input.

9. When the LTI-CT system is said to be causal?

An LTI continuous time system is causal if and only if its impulse response is zero for negative values of t.

10. When the LTI-CT system is said to be stable?

A LTI-CT system is said to be stable if the impulse response of the system is absolutely integrable. That is

h(t) < 4

11. Define natural response.

Natural response is the response of the system with zero input. It depends on the initial state of the system. It is denoted by Y_n (t).

12. Define forced response.

Forced response is the response of the system due to input alone when the initial state of the system is zero. It is denoted by Y_f (t).

13. Define complete response.

The complete response of a LTI-CT system is obtained by adding the natural response and forced response.

$Y(t)= Y_n (t)+ Y_f (t)$.

14. Draw the direct form I implementation of CT systems.

15. Draw the direct form II implementation of CT systems.

16. Mention the advantages of direct form II structure over direct form I structure.

No. of integrators are reduced to half

17. Define Eigen function and Eigen value.

In the equation given below,

$y(t)=H(s)\ e^{st}$

H(s) is called Eigen value and e^{st} is called Eigen function.

18. Define Causality and stability using poles.

For a system to be stable and causal, all the poles must be located in the left half of the s plan.

19. Find the impulse response of the system y (t) =x (t-t_0) using Laplace transform.

Ans:

$h(s)= d (t-t_0)$

20. The impulse response of the LTI CT system is given as h(t)=e -t u(t). Determine transfer function and check whether the system is causal and stable.

Ans:

H(s)=1/(s+1)

The system is causal, stable.

PART- B

1. Derive convolution integral and also state and prove the properties of the same.
2. Explain the properties of LTI CT system interms of impulse response.
3. Write the properties of LTI CT systems..
4. Realization of LTI CT system using direct form I and II structures.
5. Finding frequency response using Fourier methods.
6. Solving differential equations using Fourier methods
7. Solving Differential Equations using Laplace transforms.
8. Obtaining state variable description.
9. State and prove the sampling theorem. Also explain how reconstruction of original signal is done from sampled signal.
10. Find the Z – transform of the signal ((i)x(n)= n a^n u(n) (ii)x(n)= an cos(n) u(n)
11. Determine the inverse z transform of the following function x(z)=1/(1+z-1) (1-z-1)2 |Z>1|
12. Explain the properties of z-transform
13. Find the z-transform of x(z)= 1+2z-1 / 1- 2z-1 + z-2 if x(n) is anti causal using long division method.
14. Find the inverse z-transform of x(z)= 1+3z-1 / 1+ 3z-1 + 2z-2 using residue method.
15. Give the relationship between z-transform and fourier transform.

UNIT-4
ANALYSIS OF DISCRETE TIME SIGNALS
PART-A

1. Define DTFT.

Let us consider the discrete time signal x(n).Its DTFT is denoted as X(w). It is given as $X(w)= x(n)e^{-jwn}$

2. State the condition for existence of DTFT?

The conditions are

• If x(n)is absolutely summable then

| x (n) |<1

• If x(n) is not absolutely summable then it should have finite energy for DTFT to exit.

3. List the properties of DTFT.

Periodicity
Linearity
Time shift
Frequency shift
Scaling
Differentiation in frequency domain
Time reversal
Convolution
Multiplication in time domain
Parseval‘s theorem

4. What is the DTFT of unit sample?

The DTFT of unit sample is 1 for all values of w.

5. Define DFT.

DFT is defined as X (w) = x (n)e
Here x(n) is the discrete time sequence
X (w) is the fourier transform of x (n).

6. Define Twiddle factor.

The Twiddle factor is defined as $Wk^{N}=e^{-j2 /N}$

7. Define Zero padding.

The method of appending zero in the given sequence is called as Zero padding.

8. Define circularly even sequence.

A Sequence is said to be circularly even if it is symmetric about the point zero on the circle.
x(N-n)=x(n),1<=n<=N-1.

9. Define circularly odd sequence.

A Sequence is said to be circularly odd if it is anti symmetric about point x(0) on the circle

10. Define circularly folded sequences.

A circularly folded sequence is represented as x((-n)) N . It is obtained by plotting x(n) in clockwise direction along the circle.

11. State circular convolution.

This property states that multiplication of two DFT is equal to circular convolution of their sequence in time domain.

12. State Parsevals theorem.

Consider the complex valued sequences x(n) and y(n).If
x(n) ---- X(k)
y(n) ---- Y(k)

then x(n)y*(n)=1/N X(k)Y*(k)

13. Define Z transform.

The Z transform of a discrete time signal x(n) is denoted by X(z) and is given by X(z)= x(n)Z -n .

14. Define ROC.

The value of Z for which the Z transform converged is called region of Convergence.

15. Find Z transform of x(n)={1,2,3,4}

x(n)= {1,2,3,4}

-n X(z)= x(n)z

-1 -2 -3. = 1+2z +3z +4z

2 3 = 1+2/z+3/z +4/z .

16. State the convolution property of Z transforms.

The convolution property states that the convolution of two sequences in time domain is equivalent to multiplication of their Z transforms.

17. Find the z transform of (n-m)?

By time shifting property

Z[A (n-m)]=A e^{-m} x(n)

18. State initial value theorem.

If x(n) is causal sequence then its initial value is given b y

x(0)=lim X(z)

19. List the methods of obtaining inverse Z transform.

Inverse z transform can be obtained by using

Partial fraction expansion.

Contour integration

Power series expansion

Convolution.

20. Obtain the inverse z transform of X(z)=1/z-a,|z|>|a|

Given X(z)=z -1 /1-az -1

By time shifting property

X(n)=a n .u(n-1)

PART-B

1. Give the properties of convolution.
2. Determine the step response of the difference equation, y(n)-(1/9)y(n-2)=x(n-1) with y(-1)=1 and y(-2)=0
3. Find the impulse response and step response.
   Y(n)-3/4y(n-1) +1/8 y(n-2) = x(n)
4. Find the output y(n) of a linear time invariant discrete time system specified by the equation.
   Y(n)-3/2y(n-1) +1/2 y(n-2) = 2x(n) +3/2 x(n-1) when initial conditions are y(-1)=0,y(-2) = 1 and input x(n)=(1/4)n u(n)
5. Determine the Nyquist sampling rate and Nyquist sampling intervals for
   sinc(200t) + 3sinc2(120t)
6. Find the frequency response of the following causal system.
   Y(n)=1/2x(n)+x(n-1)+1/2 x(n-2) (4)
7. Determine inverse Discrete Time Fourier Transform of X(k)={1,0,1,0}
8. Give the summary of elementary blocks used to represent discrete time systems .
9. Explain ROC and its properties.
10. State and prove the properties of Z transform.

UNIT-5
LINEAR TIME INVARIANT DISCRETE TIME SYSTEMS

PART-A

1. Define convolution sum?
If x(n) and h(n) are discrete variable functions, then its convolution sum
y(n) is given by,
y(n)= x(k)* h(n-k)
2. List the steps involved in finding convolution sum?
Folding
Shifting
Multiplication
Summation
3.List the properties of convolution?
Commutative property of convolution
x(n) * h(n) = h(n) *x(n) = y(n)
Associative property o f convolution
[x(n) *h (n)]* h (n) = x(n)* [h (n)* h (n)]
Distributive property of convolution
x(n) [h (n) + h (n)] = x (n) h (n) + x(n) h (n)
4. Define LTI causal system?
A LTI system is causal if and only if ,h(n) = 0 for n<0.This is the sufficient
and necessary condition for causality of the system.
5. Define LTI stable system?
The bounded input x(n) produces bounded output y(n) in the LTI system only
if, | h(k)| <8. When this condition is satisfied ,the system will be stable.
6. Define FIR system?
The systems for which unit step response h(n) has finite number of terms, they
are called Finite Impulse Response (FIR) systems.
7. Define IIR system?
The systems for which unit step response h(n) has infinite number of terms,
they are called Infinite Impulse Response (IIR) systems.
8. Define non recursive and recursive systems?
When the output y(n) of the system depends upon present and past inputs
then it is called non-recursive system.
When the output y(n) of the system depends upon present and past inputs as
well as past outputs, then it is called recursive system.
9. State the relation between fourier transform and z transform?
The fourier transform is basically z-transform of the sequence evaluated on
unit circle.
i.e., X(z)| = X( ) at |z|=1 i.e., unit circle. z=e
10. Define system function?
H(z)= Y(z) is called system function. It is the z transform of the unit
Sample X(Z) response h(n) of the system.
11. What is the advantage of direct form 2 over direct form 1 structure?
The direct form 2 structure has reduced memory requirement compared to
direct form 1 structure.
12. Define butterfly computation?
In the figure the two values ‗a‘ and ‗b‘ are available as input. From these two
values
‗A‘ and ‗B‘ are computed at the output. This operation is called Butterfly computation.

13.What is an advantage of FFT over DFT?

FFT algorithm reduces number of computations.

14. List the applications of FFT?

- Filtering
- Spectrum analysis
- Calculation of energy spectral density

15. How unit sample response of discrete time system is defined?

The unit step response of the discrete time system is output of the system to unit sample sequence. i.e., T[ð(n)]=h(n). Also h(n)=z {H(z)}.

16.A causal DT system is BIBO stable only if its transfer function has _____.

Ans: A causal DT system is stable if poles of its transfer function lie within the unit circle.

17. If u(n) is the impulse response of the system, What is its step response?

Here h(n) = u(n) and the input is x(n) = u(n).

Hence the output y(n) = h(n) * x(n)

= u(n)* u(n)

18.Convolve the two sequences x(n)={1,2,3} and h(n)={5,4,6,2}

Ans: y(n)={5,14,29,26,22,6}

19. State the maximum memory requirement of N point DFT including twiddle factors?

Ans: [2N+N/2]

20. Determine the range of values of the parameter 'a' for which the linear time invariant system with impulse response h(n)=a n u(n) is stable?

Ans: H(z)= z , There is one pole at z=a. The system is stable, if all its poles.

z-a

i.e., within the unit circle. Hence |a| < 1 for stability.

PART-B

1. State and prove the properties of convolution sum?
2. Determine the convolution of x(n)={1,1,2} h(n)=u(n) graphically?
3. Determine the forced response for the following system

   y(n)-1 y(n-1) – 1 y(n-2) = x(n) + x (n-1)

   for x(n)=(1/8) n u(n) . Assume zero initial conditions?
4. Compute the response of the system

   y(n)=0.7 y(n-1) – 0.12 y(n-2) + x (n-1) – x (n-2) to the input x(n) = n u(n).
5. Derive the 8 point DIT and DIF algorithms.
6. Determine the transposed structure for the system given by difference equation

   y(n)=(1/2)y(n-1)-(1/4)y(n-2)+x(n)+x(n-1)
7. Realize H(s)=s(s+2)/(s+1)(s+3)(s+4) in cascade form
8. A difference equation of a discrete time system is given below:

   y(n)-3/4 y(n-1) +1/8 y(n-1) = x(n) +1/2 x(n-1)

draw direct form I and direct form II.

9. Realize the following structure in direct form II and direct form I

   H(s) = s+1/s2 + 3s+5
10. Determine the recursive and nonrecursive system.
11. Determine the parallel form realization of the discrete time system is

   y(n) -1/4y(n-1) -1/8 y(n-2) = x(n) +3x(n-1)+2x(n-2)

Reg. No. :

Question Paper Code : 31354

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2013.

Third Semester

Electronics and Communication Engineering

EC 2204/EC 35/EC 1202 A/080290015/10144 EC 305 — SIGNALS AND SYSTEMS

(Regulation 2008/2010)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Give the mathematical and graphical representation of continuous time and discrete time unit impulse function.
2. What are the conditions for a system to be LTI system?
3. State Dirichlet's conditions.
4. Give the equation for trigonometric Fourier series.
5. What are the three elementary operations in block diagram representation of continuous time system?
6. Check whether the causal system with transfer function $H(s)=\frac{1}{s-2}$ is stable.
7. What is aliasing?
8. Define unilateral and bilateral Z transform.
9. Define convolution sum with its equation.
10. Check whether the system with system function $H(z)=\frac{1}{1-\frac{1}{2}z^{-1}}+\frac{1}{1-2z^{-1}}$ with ROC $|Z|<\frac{1}{2}$ is causal and stable.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Determine whether the signal $x(t)=\sin 20\pi t+\sin 5\pi t$ is periodic and if it is periodic find the fundamental period. (5)

(ii) Define energy and power signals. Find whether the signal $x(n)=\left(\frac{1}{2}\right)^n u(n)$ is energy or power signal and calculate their energy or power. (5)

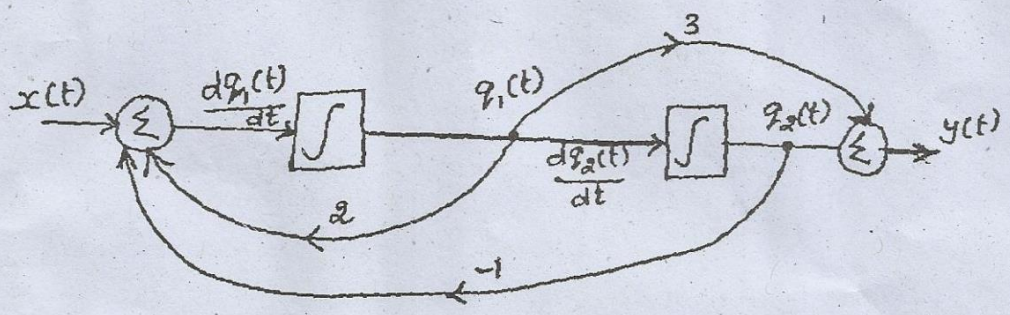
(iii) Discuss various forms of real and complex exponential signals with graphical representation. (6)

Or

(b) (i) Draw direct form, cascade form and parallel form of a system with system function.

$$H(s)=\frac{1}{(s+1)(s+2)}.$$ (8)

(ii) Determine the state variable description corresponding to the block diagram given below. (8)



14. (a) (i) Determine the discrete time Fourier transform of $x(n)=a^{|n|}$, $|a|<1$. (8)

(ii) Find the z transform and ROC of the sequence $x(n)=r^n\cos(n\theta)u(n)$. (8)

Or

(b) (i) State and prove the following properties of z transform

(1) Linearity

(2) Time shifting

(3) Differentiation

(4) Correlation. (8)

(ii) Find the inverse z-transform of the function

$$X(z)=\frac{1+z^{-1}}{\left(1-\frac{2}{3}z^{-1}\right)^2} \text{ ROC } |z|>\frac{2}{3}.$$ (8)

Reg. No. : [ ]

Question Paper Code : 21445

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Electronics and Communication Engineering

EC 2204/EC 35/EC 1202 A/080290015/10144 EC 305 — SIGNALS AND SYSTEMS

(Common to Biomedical Engineering)

(Regulations 2008/2010)

Time : Three hours Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Given $x(n)=\{1,2,\underset{\uparrow}{3},-4,6\}$ Plot the signal $x[n-1]$.

2. Define power signal.

3. Define Fourier transform pair for continuous time signal.

4. Find the Laplace transform of an unit step function.

5. State the condition for LTI system to be causal and stable.

6. Differentiate between natural response and forced response.

7. Define Z — transform.

8. State the relation between DTFT and Z — transform.

9. List the four steps used to obtain convolution.

10. What is state transition matrix?

PART B — (5 × 16 = 80 marks)

11. (a) (i) Given $y[n]=n\,x[n]$. Determine whether the system is memoryless, causal, linear and time invariant. (8)

(ii) Describe the classification of systems. (8)

Or

(b) (i) Compute the linear convolution of $x[n]=\{\underset{\uparrow}{1},1,0,1,1\}$ and $h[n]=\{\underset{\uparrow}{1},-2,-3,4\}$. (8)

(ii) Distinguish between random and deterministic signals. (8)

12. (a) (i) Find the Laplace transform of $X(s)=\dfrac{1}{(s+1)(s+2)}$. (8)

(ii) State and prove the Parseval's relation for continuous time signals using Fourier transform. (8)

Or

(b) (i) State and prove any two properties of continuous time Fourier transform. (8)

(ii) Determine the Fourier series representation for $x(t)=2\sin(2\pi t-3)+\sin(6\pi t)$. (8)

13. (a) Find the natural response of the system described by the difference equation $\dfrac{d^2y(t)}{dt^2}+6\dfrac{dy(t)}{dt}+8y(t)=\dfrac{dx(t)}{dt}+2x(t)$. The initial conditions are $y(0+)=2;\dfrac{dy(0+)}{dt}=3$. (16)

Or

(b) Derive the expression for convolution integral. Explain any three properties of convolution integral in detail. (16

14. (a) (i) Compute DTFT of a sequence $x[n]=(n-1)x[n]$. Use DTF properties. (

(ii) Find the discrete time Fourier transform of $x[n]=[1/2]^{n-1}u[n-1]$. (

Or

(b) State and prove the properties of z — transform. (1

15. (a) State and prove the properties of discrete Fourier transform.

Or

(b) (i) Find the DFT of the signal $x[n] = \begin{cases} 1, & 0 \le n \le L-1 \\ 0, & \text{otherwise} \end{cases}$.

(ii) Find the six point DFT of $x[n] = \{1, 1, 1, 0, 0, 1\}$.

Reg. No. | 1 | 1 | 0 | 3 | 1 | 3 | 1 | 0 | 6 | 3 | 1 | 0 |

Question Paper Code : 57282

B.E/B.Tech. DEGREE EXAMINATION, MAY/JUNE 2016

Third Semester

Electronics and Communication Engineering

EC 6303 – SIGNALS AND SYSTEMS

(Common to Biomedical Engineering and Medical Electronics Engineering)

(Regulations 2013)

Time : Three Hours **Maximum : 100 Marks**

Answer ALL questions.

PART – A (10 × 2 = 20 Marks)

1. Sketch the following signals :

   $\text{rect}\left(\frac{t+1}{4}\right)$; 5 ramp (0.1t)

2. Given $g(n) = 2e^{-2n-3}$. Write out and simplify the functions

   (i) $g(2-n)$ (ii) $g\left(\frac{n}{10}+4\right)$

3. What is the inverse Fourier transform of

   (i) $e^{-j2\pi f t_0}$ (ii) $\delta(f-f_0)$

4. Give the Laplace Transform of $x(t) = 3e^{-2t}u(t) - 2e^{-t}u(t)$ with ROC.

5. Find whether the following system whose impulse response is given is causal and stable $h(t) = e^{-2t}u(t-1)$.

6. Realize the block diagram representing the system $H(s) = \frac{s}{s+1}$.

7. Write the conditions for existence of DTFT.

8. Find the final value of the given signal

$$X(z) = \frac{1}{1 + 2z^{-1} + 3z^{-2}}$$

9. From discrete convolution sum, find the step response in terms of h(n).

10. Define the non recursive system.

PART – B (5 × 16 = 80 Marks)

11. (a) (i) Find whether the following signals are periodic or aperiodic. If periodic find the fundamental period and fundamental frequency **(8)**

$$x_1(n) = \sin 2\pi t + \cos \pi t$$

$$x_2(n) = \sin \frac{n\pi}{3} \cdot \cos \frac{n\pi}{5}$$

(ii) Find whether the following signals are power or energy signals. Determine power and energy of the signals. **(8)**

$$g(t) = 5 \cos\left(17\pi t + \frac{\pi}{4}\right) + 2 \sin\left(19\pi t + \frac{\pi}{3}\right)$$

$$g(n) = (0.5)^n u(n)$$

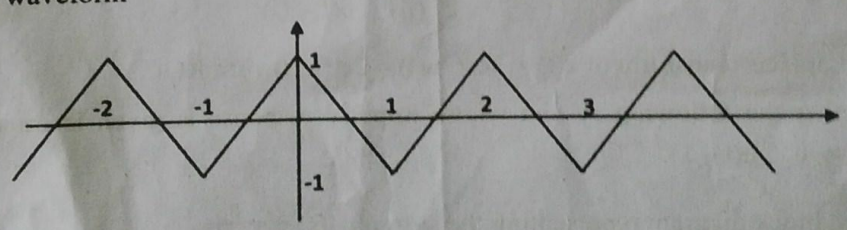
OR

(b) Find whether the following systems are time variant or fixed. Also find whether the systems are linear or nonlinear

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 5\frac{dy}{dt} + y^2t = x(t)$$ **(8)**

$$y(n) = an^2 \times (n) + bn \times (n-2)$$ **(8)**

12. (a) Obtain the Fourier series coefficients & Plot the spectrum for the given waveform **(16)**



OR

(b) (i) From basic formula, determine the Fourier transform of the given signals. Obtain the magnitude and phase spectra of the given signals. (5 + 5)

$te^{-at}u(t)$, $a > 0$

$e^{-a|t|}$, $a > 0$

(ii) State and prove Rayleigh's energy theorem. (6)

13. (a) (i) Using graphical convolution, find the response of the system whose impulse response is (8)

$$h(t) = e^{-2t}u(t)$$

for an input $x(t) = \begin{cases} A, & \text{for } 0 \le t \le 2 \\ 0, & \text{otherwise} \end{cases}$

(ii) Realize the following is indirect form II. (8)

$$\frac{d^3y(t)}{dt^3} + 4\frac{d^2y(t)}{dt^2} + 7\frac{dy(t)}{dt} + 8y(t) = 5\frac{d^2x(t)}{dt^2} + 4\frac{dx(t)}{dt} + 7x(t)$$

OR

(b) (i) An LTI system is defined by the differential equation (10)

$$\frac{d^2y(t)}{dt^2} - 4\frac{dy(t)}{dt} + 5y(t) = 5x(t)$$

Find the response of the system $y(t)$ for an input $x(t) = u(t)$, if the initial conditions are $y(0) = 1$; $\left.\frac{dy(t)}{dt}\right|_{t=0} = 2$.

(ii) Determine frequency response and impulse response for the system described by the following differential equation. Assume zero initial conditions. (6)

$$\frac{dy(t)}{dt} + 3y(t) = x(t)$$

14. (a) (i) State and prove sampling theorem. (10)

(ii) What is aliasing ? Explain the steps to be taken to avoid aliasing. (6)

OR

(b) State and prove the following theorems :

(i) Convolution theorem of DTFT (8)

(ii) Initial value theorem of z-transform (8)

15. (a) (i) Realise the following system in cascade form **(10)**

$$H(z) = \frac{1 + \frac{1}{5} z^{-1}}{\left(1 - \frac{1}{2} z^{-1} + \frac{1}{3} z^{-2}\right)\left(1 + \frac{1}{4} z^{-1}\right)}$$

(ii) Convolve $x(n) = \{1, 1, 0, 1, 1\}$ **(6)**

$$\uparrow$$

$$h(n) = \{1, -2, -3, 4\}$$

$$\uparrow$$

OR

(b) A system is governed by a linear constant coefficient difference equation

$$y(n) = 0.7\, y(n-1) - 0.1\, y(n-2) + 2x(n) - x(n-2)$$

Find the output response of the system y(n) for an input $x(n) = u(n)$ **(16)**

EC6304 ELECTRONIC CIRCUITS – I **L T P C 3 1 0 4**

UNIT I POWER SUPPLIES AND BIASING OF DISCRETE BJT AND MOSFET 9

Rectifiers with filters- DC Load line, operating point, Various biasing methods for BJT-Design-Stability-Bias compensation, Thermal stability, Design of biasing for JFET, Design of biasing for MOSFET

UNIT II BJT AMPLIFIERS 9

Small signal Analysis of Common Emitter-AC Load line, Voltage swing limitations, Common collector and common base amplifiers – Differential amplifiers- CMRR- Darlington Amplifier- Bootstrap technique - Cascaded stages - Cascode Amplifier-**Large signal Amplifiers – Class A , Class B and Class C Power Amplifiers .**

UNIT III JFET AND MOSFET AMPLIFIERS 9

Small signal analysis of JFET amplifiers- Small signal Analysis of MOSFET and JFET, Common source amplifier, Voltage swing limitations, Small signal analysis of MOSFET and JFET Source follower and Common Gate amplifiers, - BiMOS Cascode amplifier

UNIT IV FREQUENCY ANALYSIS OF BJT AND MOSFET AMPLIFIERS 9

Low frequency and Miller effect, High frequency analysis of CE and MOSFET CS amplifier, Short circuit current gain, cut off frequency – $f\alpha$ and $f\beta$ unity gain and Determination of bandwidth of single stage and multistage amplifiers

UNIT V IC MOSFET AMPLIFIERS 9

IC Amplifiers- IC biasing Current steering circuit using MOSFET- MOSFET current sources-PMOS and NMOS current sources. Amplifier with active loads - enhancement load, Depletion load and PMOS and NMOS current sources load- CMOS common source and source follower-CMOS differential amplifier- CMRR.

TOTAL (L: 45+T: 15): 60 PERIODS

TEXT BOOK:

1. Donald .A. Neamen, Electronic Circuit Analysis and Design –2nd Edition,Tata Mc GrawHill, 2009.

REFERENCES:

1. Adel .S. Sedra, Kenneth C. Smith, “Micro Electronic Circuits”, 6th Edition, OxfordUniversity Press, 2010.
2. David A., “Bell Electronic Devices and Circuits”, Oxford Higher Education Press, 5th Edition, 2010
3. Behzad Razavi, “Design of Analog CMOS Integrated Circuits”, Tata Mc Graw Hill, 2007.
4. Paul Gray, Hurst, Lewis, Meyer “Analysis and Design of Analog Integrated Circuits”, 4th Edition ,JohnWilley & Sons 2005
5. Millman.J. and Halkias C.C, “Integrated Electronics”, Mc Graw Hill, 2001.
6. D.Schilling and C.Belove, “Electronic Circuits”, 3rd Edition, Mc Graw Hill, 1989.
7. Robert L. Boylestad and Louis Nasheresky, “Electronic Devices and Circuit Theory”, 10th Edition,Pearson Education / PHI, 2008.

UNIT -1 BIASING OF DISCRETE BJT AND MOSFET

1) **Why do we choose Q point at the center of the load line. (NOV 2016) (APR 2015) (NOV 2015)**

The operating point of a transistor is kept fixed usually at the center of the active region in order that the input signal is well amplified. If the point is fixed in the saturation region or the cut off region the positive and negative half cycle gets clipped off respectively.

2) Name the two techniques used in the stability of the Q point.

Stabilization technique: This refers to the use of resistive biasing circuit which allows IB to vary so as to keep IC relatively constant with variations in Ico,_, and VBE. Compensation techniques: This refers to the use of temperature sensitive devices such as thermistors diodes. They provide compensating voltages &currents to maintain operating point constant.

3) Give the expression for the stability factor

$$S = \frac{1+\beta}{1-\beta(\partial\frac{IB}{\partial IC})}$$

4) List out the difference types of biasing.

Voltage divider bias
Base bias
Emitter feed back bias
Collector feedback bias

5) What do you mean by thermal runway?

Due to the self heating at the collector junction, the collector current rises. This causes damage to the device. This phenomenon is called thermal runway.

6) What is Biasing

To use the transistor in any application it is necessary to provide sufficient voltage and current to operate the transistor. This is called biasing.

7) What is stability factor? (NOV 2015)

Stability factor is defined as the rate of change of collector current with respect to the rate of change of reverse saturation current.

8) What are the advantages of fixed bias circuit.

This is simple circuit which uses a few components. The operating point can be fixed any where on the Centre of the active region

9) List the advantage of Transistor?

Low operating voltage
High Frequency
Small Size and ruggedness
Does not require filament power.

10) Define DC Biasing

In order to operate transistor in the desired region we have to apply external DC voltage of correct polarity and magnitude to the two junctions of the transistor.

11 what are the factors against which an amplifier need to be stabilized?

The stability factor indicates the degree of charge in operating point due to variation in β,ic_0 and V_{BE}

12) Define Stability Factor. (APR 2017)

Stability factor is defined as the rate of change of collector current with respect to the rate of change of reverse saturation current.

13) Why thermal runaway is not there in FETs?

FET is temperature dependent. In FET, as temperature increases drain resistance also increases‘, reducing the drain current. So thermal runaway does not occur in FET.

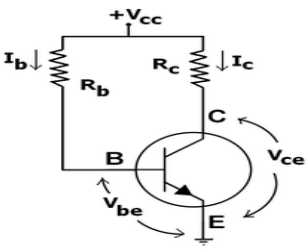
14) What is meant by compensating techniques? ***(MAY/JUNE-2006)***

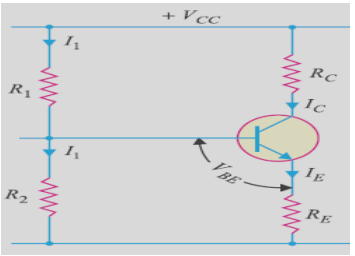
Use of temperature-sensitive devices such as diodes, transistors, thermistors, etc., which provide compensating voltages and currents to maintain the operating point stable.

15) Write short notes on zero current drift in FET ***(APRIL/MAY-2008)***

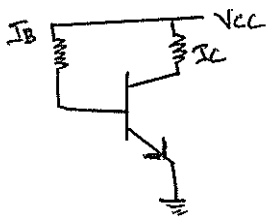
In JFET, the drain current varies with changes in the temperature due to two factors. One factor increases drain current and other factor decreases drain current with increase in temperature. Therefore, it is possible to design biasing circuit which compensates these tow factors so that there is no c hange of drain current with temperature. Such biasing is called biasing for zero current drift.

16) Draw the fixed bias & Self bias circuit?





17) For the circuit shown in figure determine the operating point with B=100.



$$I_B = \frac{V_{CC} - V_{BE}}{R_B}$$

$$V_{CE} = 6V$$

18) What is reverse saturation current?

The current due to the minority carriers is called the reverse saturation current.

19) How are amplifier classified according to the input?

Small signal Amplifiers Large signal Amplifiers

20) What is operating point.

The operating point of a device, also known as bias point, quiescent point, or Q-point, is the steady-state voltage or current at a specified terminal of an active device (a transistor or vacuum tube) with no input signal applied.

Part – B (16 Marks)

1) Explain the voltage divider bias method & derive an expression for stability factors.

2. Why biasing is necessary in BJT amplifier? Explain the concept of DC & AC load line with neat diagram. How will you select the operating point, explain it using CE amplifier characteristics?

3. Explain the collector feedback bias amplifier & derive an expression for stability factors.

4. Explain the fixed bias method & derive an expression for stability factors.

5. Derive an expression for all stability factors & CE configuration S equation.

6. Explain about common source self- bias & voltage divider bias for FET.

7. Explain in details about biasing MOSFET.

8. Discuss the various types of bias compensation.

9. The fixed bias circuit as shown in figure is subjected to an increase in junction temperature from 25oC to 75oC. If β is 125 at 75oC. Determine the percentage change in Q point values (Vce, Ic) over temperature change. Neglect any change in VBE.

10. A self bias circuit has RE=1 kΩ, R1=130 kΩ, R2=10 kΩ. If Vcc and Rc are adjusted to give Ic=1mA at 10oC. Calculate the variation in Ic over temperature change of 10oC to 100oC. The transistor used has the parameters given below

Parameters	**o**	**100^oC**
Ico (μA)	0.01	1.2
V_{BE}(v)	0.74	0.54
β	60	140

11. Design a collector to base bias circuit to have operating point (10v, 4mA). The circuit is supplied with 20v and uses a silicon transistor of h_{fe} is 250.

12. Design a voltage divider bias circuit for the specified conditions. V_{CC}=12v, V_{CE}=6v, I_C=1mA, S=20, β=100 and V_E=1v

UNIT -2 BJT AMPLIFIERS

1) What is the overall current gain for a cascade connection?

The overall current gain of cascade connection is

2) What does Bootstrapping Mean?

When AV=1 it is called bootstrapping. The name arises from the fact that, if one end of the resistor R3 changes in voltage, the other end of R3 moves through the same potential difference; it is as if R3 is pulling itself up by its bootstraps.

3) State Miller‘s Theorem.*(NOV/DEC-2006),(APRIL/MAY-2008)* (APR 2017) (NOV 2015)

Miller‘s theorem states that, the effect of resistance Z on the input circuit is a ratio of input voltage Vi to the current I which flows from the input to the output**.** Miller‘s theorem states that, the effect of resistance Z on the output circuit is a ratio of output voltage Vo to the current I which flows from the output to the input.

4) What are the techniques used to improve input impedance.

- Using direct coupling (Darlington connection)
- Using Bootstrap techniques

5) Give the advantages of h- parameters.

- Real numbers at audio frequencies
- Easy to measure
- Can be obtained from the transistor static characteristic curves
- Convenient to use in circuit analysis and design.
- Most of the transistor manufacturers specify the h-parameter.

6) Define CMRR? (NOV 2016) (APR 2015)

The ability of a differential amplifier to reject a common mode signal is expressed by a ratio called common mode rejection ratio denoted as CMRR. It is defined as the ratio of the differential voltage gain Ad to common mode voltage gain Ac **CMRR= (Ad / Ac**)

7) State the equation of Ad & Ac.

Ad(db) = 20 log 10 [vo/vd]

8) How CMRR can be improved.

To improve the CMRR, the common mode gain Ac must be reduced. The common mode gain Ac approaches zero as RE tends to infinity. This is because RE introduces a negative feedback in the common mode operation which reduces the common mode gain Ac. Thus higher the value of RE, lesser is the value of Ac and higher is the value of CMRR. The differential gain Ad is not dependent on RE.

9) State the methods of coupling multistage amplifiers. (NOV 2016)

- RC coupling
- Transformer coupling
- Direct coupling

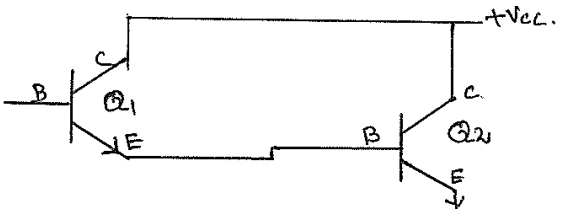
10) State the advantages of RC Coupled Amplifier.

- Wide frequency response
- Most convenient coupling
- No core distortion
- High fidelity Amplifier

11)State the application of Transformer Coupled Amplifier.

- For Impedance Matching
- For amplification of RF Signal
- In Power Amplifiers
- Transforming power to low impedance load

12) Draw the Darling ton pair connection diagram?



13) State the advantages of Darlington emitter follower.

ADVANTAGES:

- Very high current gain
- Very high input impedance for overall circuit
- Darlington pairs are widely available in a single package or they can be made from two separate transistors
- Convenient and easy circuit configuration to use

14) State the features of Darlington emitter follower.

- Very high current gain
- Very low voltage gain
- Very high input resistance
- Very low output resistance

15) What do you mean by faithful amplification ?

The shape of the output voltage is exactly same as that of input. That means no waveform distortion has taken place. The process of raising the strength of a weak signal without any change in its general shape is known as faithful amplification.

16) State the various two stages cascaded amplifiers.

- CE-CE CASCADE
- CC-CE CASCADE
- CE-CC CASCADE
- CE-CB CASCADE
- CB-CC CASCADE
- CC-CB CASCADE

17. Define class C operation of power amplifier?

In a class C amplifier the transistor bias and amplitude of the input signal are selected such that the output current flows the transistor is ON for less than one half cycle of the input ac signal.

18. Why class A amplifier must not be operated under no signal conditions?

When there is no input signal the power dissipation must be zero, but here the power dissipation is present due to this reason the class A power amplifier is not used under any signal condition.

19. Which power amplifier gives minimum distortion and Why?

- Class A Power amplifier is distortion free
- Collector current flows for the whole that is for 360 degree of the input cycle.

20. When does inter modulation distortion occur? Why should it be minimized in audio amplifier?

Inter modulation distortion an amplifier arises when the input signal consists of two different frequencies f1 and f2. If the active device is nonlinear the output consists of fundamental the harmonic components f1+f2 and f1-f2. These frequencies are called inter modulation distortion. It may not to be eliminated.

21. What is the drawback of class B amplifier? How is this minimized?

In class B amplifier only a half cycle is obtained at the output for full input cycle the output signal is distorted in this mode of operation . to eliminate this distortion two transistor are used in the alternate half cycle of the input signal. Thus the overall full cycle of output is obtained across the load because each transistor conducts for half cycle.

22. What are the advantages of push pull amplifier?

- Efficiency is much higher than the class A operation
- When there is no input signal the power dissipation is zero
- The even harmonics get cancelled . this reduces the harmonic distortion

23. What is cross over distortion? How it can be eliminated.

In class B amplifier the transistor is supposed to operate for full half cycle of the input. But Because of the cut in voltage, the transistor starts conducting only after 0.7V. the distortion caused by this is called cross over distortion. This can be eliminated by using two complementary transistor to conduct in alternate half cycle.

PART – B (16 MARKS)

1) Draw a CE amplifier & its small signal equivalent. Derive its Avs, Ai, Rin, Ro.

2. Explain with circuit diagram of Darlington connection and derive the expression for Ai, Av, Ri &Ro.

3. Explain Bootstrap emitter follower circuit. Compare CE, CB, CC amplifiers.

4. Derive expression for voltage gain of CS & CD amplifier under small signal low frequency condition.

5. Explain the emitter coupled differential amplifier with neat diagram & Derive expression for CMRR.

6. Discuss transfer characteristics of differential amplifier. Explain the methods used to improve CMRR.

7. Write short notes on multistage amplifiers & Draw a two stage RC coupled amplifier and explain. Compare cascade and cascode amplifier?

8. Derive the expressions for the voltage gain, current gain, input and output impedance of emitter follower amplifier.

9. Derive the expressions for the common mode and differential mode gains of a differentia amplifier in terms of h-parameters.

10. Consider a single stage CE amplifier with Rs=1kΩ, R1=50KΩ, R2=2KΩ, RC=2KΩ, RL=2KΩ, hfe=50, hie=1.1 KΩ, hoe=25µmho, hre=2.5×10-4 . Find Ai,Ri,Av,Ais,Avs and R0.

11. The Darlington amplifier has the following parameters, Rs=3kΩ, RE=3kΩ, hie=1.1 KΩ, hfe=50, hre=2.5×10-4, hoe=25µmho. Then calculate Ai, Ri, Av and R0.

12. The dual input balanced output differential amplifier having Rs=100Ω, RC=4.7KΩ, RE=6.8KΩ, hfe=100, Vcc=+15v and VEE=-15v. Calculate operating point values, differential & common mode gain, CMRR, and output if VS1= 70mV(p-p) at 1 KHz & VS2= 40mV(p-p) at 1 KHz

13 Explain in detail class A power amplifier with a neat sketch

14 Explain in detail class B & C power amplifier with a neat sketch

UNIT –III JFET AND MOSFET AMPLIFIERS

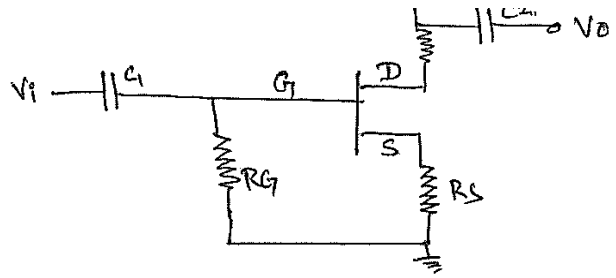
1) List the different types of FET biasing circuits.

- Fixed Bias
- Self Bias
- Voltage Divider Bias

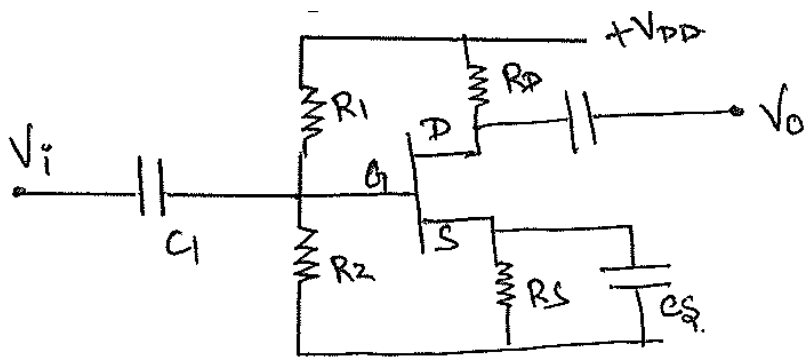
2) State the general procedure for analysis of a JFET biasing Circuit.

- Calculate VGs by applying KVL to the gate circuit
- Calculate IDg by using Shockleys equations
- Calculate VDSq by applying KVL to the drawn loop

3) Draw the source self bias circuit for FET.



4) Draw the voltage divider bias circuit for FET.



5) State the basic configuration of an E-MOSFET.

- Common source
- Common gate
- Common drain

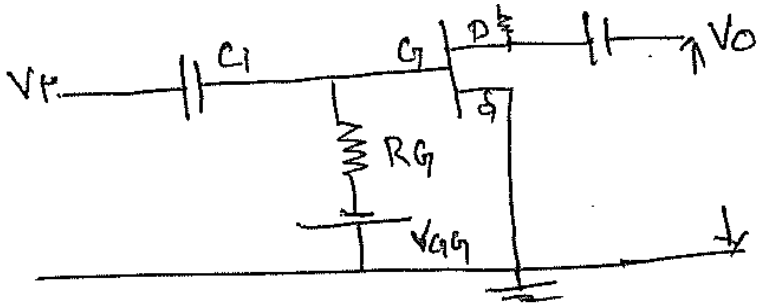
6) Why thermal runaway is not there in FETs?

Thermal runaway is not there in FET because the FET has a positive temperature coefficient of resistivity it means increase in temperature the resistance of an FET increases and hence the current through it decreases so the power dissipation decreases so it prevents thermal runaway.

7) Explain the use of JFET as a variable voltage resistor.

The FET can be used as variable voltage resistor in the region called ohmic. Since the drain to source resistance VDs in this region dependent on the gate to source voltage.

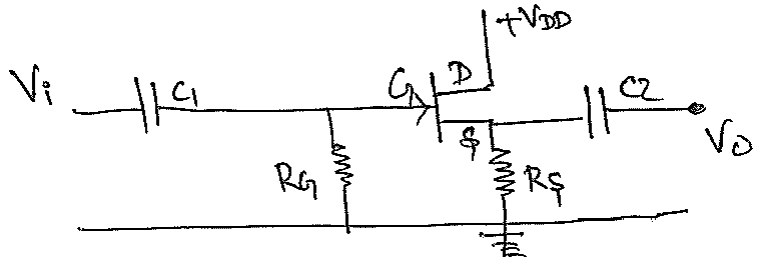
8) Draw the small signal equivalent circuit of FET. (NOV 2014)



9) State the application of CS Amplifier.

Pre Amplifier in audio circuits
P.A System
Voltage Amplifier

10) Draw the diagram of JFET Common Drain Configuration.



11) State the features of Common Drain Amplifier.

- Low voltage gain
- Very high input resistance
- Very low output resistance

12) State the procedure to be followed for the small signal analysis.

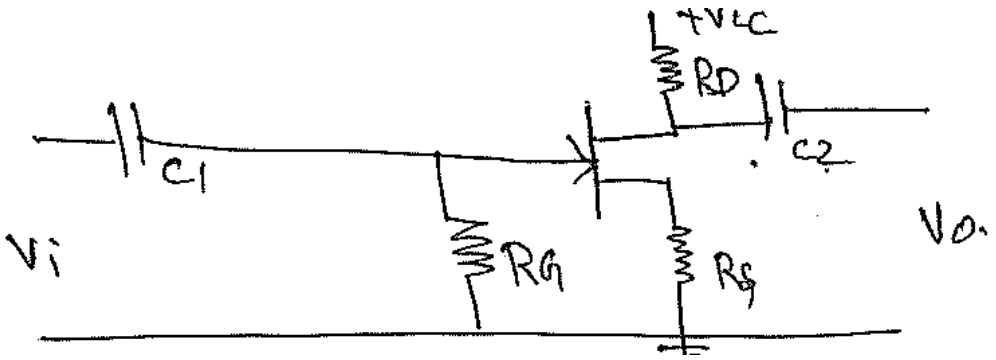
- Replace all the capacitors in the given circuit by short circuits.
- Replace all the DC voltage source by short circuit
- Replace the JFET in the circuit by its AC equivalent
- Calculate the Amplifier Parameters

13) State the formula to calculate transconductance.

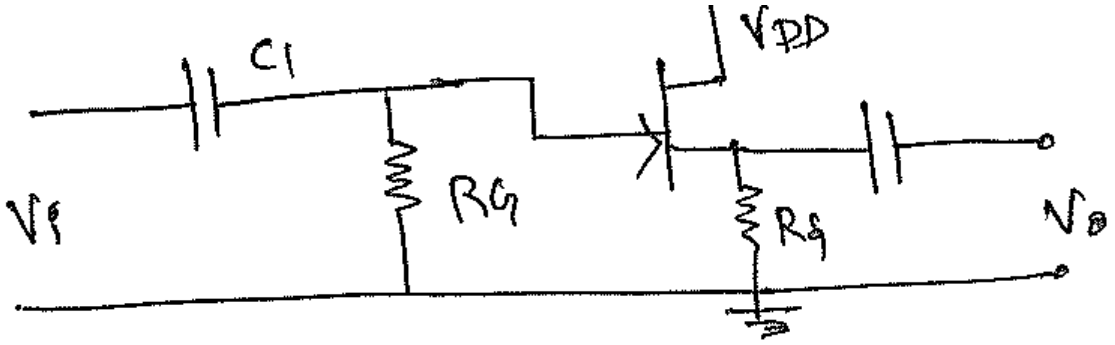
$$g_m = g_{mo}\left[1 - \frac{V_{GS}}{V_P}\right]$$

$$g_{mo} = \frac{2 I_{DSS}}{|V_P|}.$$

14) Draw the circuit diagram of CSJFET Amplifier with self Bias.



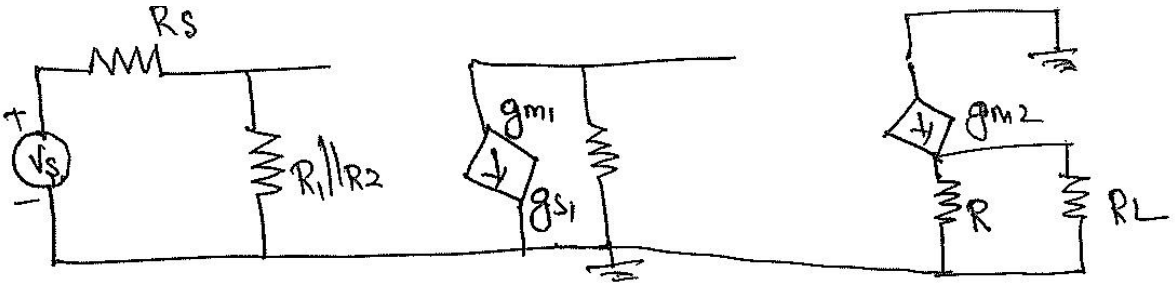
15) Draw the source follower configuration circuit.



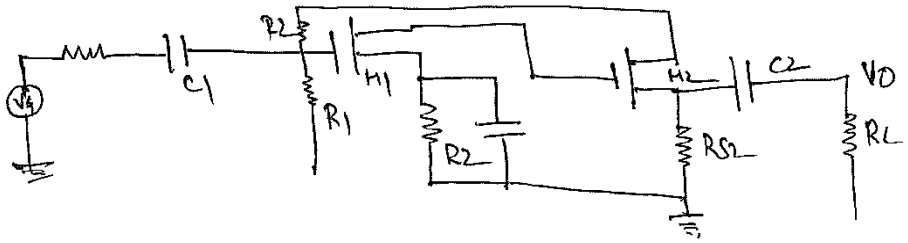
16) Two amplifiers having gain 20db & 40db are cascaded find the overall gain in db.

Overall gain = 20 + 40= 60 Db

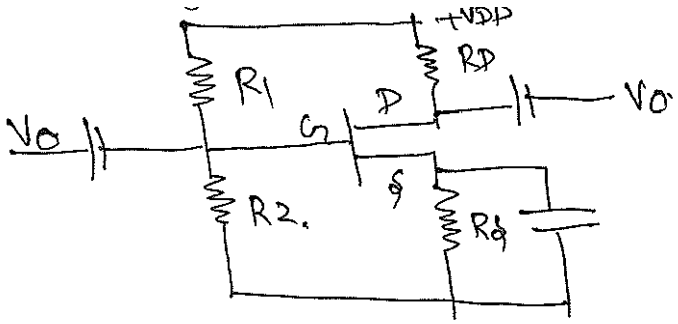
17) Draw the small signal equivalent of NMOS cascade circuit



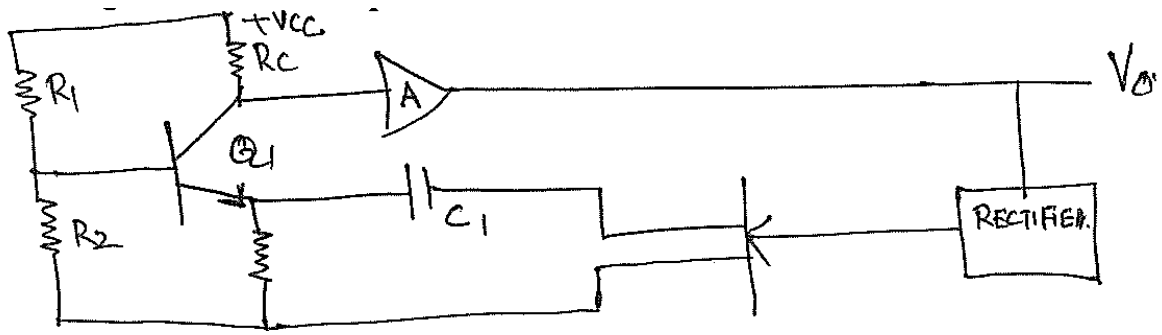
18) Draw the circuit diagram of multistage Amplifier cascade common.



19) Draw the voltage divider bias circuit.



20) Draw the diagram of AGC Amplifier.



21) What is the use of bypass source capacitor in CS amplifier? (APR 2017)

For improving the voltage gain

PART – B 16 MARKS

1. Describe the operation and analyze the basic JFET amplifier circuits.

2. Derive the small signal analysis of common source amplifier.

3. Develop a small signal model of JFET device and analyze basic JFET amplifiers.

4. Explain graphically the amplification process in a simple MOSFET amplifier circuit.

5. Describe the small signal equivalent circuit of the MOSFET and determine the values of small signal parameters?

6. Sketch the small signal high frequency circuit of a common source amplifier & derive the expression for a voltage gain, input & output admittance and input capacitance.

7. Sketch a simple source-follower amplifier circuit and discuss the general ac circuit characteristics.

8. Characterize the voltage gain and output resistance of a common-gate amplifier.

9.Calculate the small signal voltage gain of a common source amplifier such as shown in the figure assuming gm=1ma/V, ro=50 K and Rd=10 K, Assume RSi = 2k & R1parallel R2=50K.

10.The parameters of the MOSFET in the Circuit are VTN=0.8 V,Kn=0.85mA/V2 & λ=0.02 V Determine the values of Rs & Rd such that IDq=0.1ma and a maximum symmetrical 1 V peak sinusoidal signal occurs at the output find the small signal transistor parameters

11.Explain in detail BIMOS Cascade Amplifier.

12.Compare CS,CD,CG Configuration.

13.With the help of neat circuit diagram and waveform explain the operation of a CD or Souce amplifier of JFET

UNIT – IV FREQUENCY ANALYSIS OF BJT & MOSFET AMPLIFIER

1)What is bandwidth of an amplifier?

Band width of an amplifier is defined as the difference between f1 and f2. Here f2 is in the high frequency region and f1 is in the low frequency region. These two frequencies are also referred to as the half power frequencies.

2) How the rise time and bandwidth are interrelated?(APR 2017) (NOV 2014) (NOV 2015)

Bw = FH – FL~ FH

BW = 0.35/ tr

3) How the frequency response of an amplifier be improved?

The frequency response can be improved by connecting the compensating network externally to the system. Such Techniques are as follows

i) Dominant pole Compensation ii) Pole –zero Compensation

4) Define the rise time of an amplifier.

It is defined as the time that indicates how fast the amplifiers can response to the discontinuity in the input voltage.

5) Define Slew Rate?

Slew rate can be defined as the maximum rate of change of output voltage of op-amp with respect to time.

6) What are high frequency effects.

When the frequency is increased sufficiently the internal capacitances which affects the voltage gain. In high frequency range the coupling and bypass capacitor offer a very low reactance and they can be treated as short wave.

7) Define duty cycle in an amplifier.

Duty cycle is the fraction of one complete cycle for which the amplifier is in active region operation.

8) What are the effects of coupling capacitors on the bandwidth of the amplifier?

The capacitor C! & C2 are coupling capacitors used for blocking the DC part and allowing only AC part of the signal.

The capacitive reactance will increase with decrease in frequency and it will decrease with increase in frequency.

9) Define Dominant network.

The RC network having the highest critical frequency of the three networks is refered to as dominant network.

11) State the relation Fβ & Fα.

Fα=(1+hfe)Fβ

12) Briefly explain why dominant pole high frequency compensation method used in amplifiers.

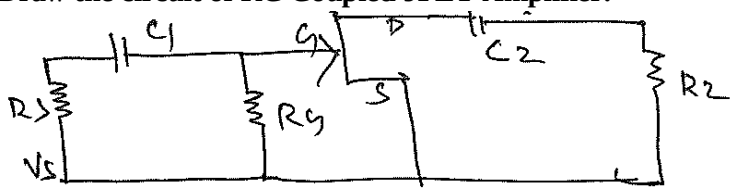
As the noise frequency components are outside the smaller bandwidth, The noise immunity of the system improves.

Adjusting value of fd adequate phase margin and stability of the system is assured.

13) Calculate the overall lower cutoff frequency. (NOV 2016)

$$f_L = \frac{f_L}{\sqrt{2^{1/n}-1}}$$

14) Draw the circuit of RC Coupled JFET Amplifier.



14) Define sag in an amplifier

The lower 3 db frequency can be eliminated from the output by measuring the sag

15) State the expression for unity gain frequency.

$$f_T = \frac{g_m}{2\pi C_e}$$

16) State the effect of bypass capacitor in FET Amplifier.

The bypass capacitor is present in FET amplifier as it bypasses the resistance connected in the source terminal of the FET.

17) Define the benefits of H-parameters.

Real numbers at audio frequencies
Easy to measure
Can be obtained from the transistor static characteristic curves
Convenient to use in circuit analysis and design.
Most of the transistor manufacturers specify the h-parameter.

18) Define Decibel.

To compare two power on a log scale rather than on a linear scale. It is known as decibel (db)

19) Write short note on gain bandwidth product.

The gain bandwidth product is

Gain X BW + Constant

20) Relation between bandwidth and rise time. (APR 2017)

The rise time is the time required for a signal to change from 10% value to a 90% of its value.

Bandwidth=$0.35/t_r$

Part – B (16 Marks)

1. With neat sketch explain hybrid π CE transistor model. Derive the expression for various components in terms of _h‘ parameters.

2. Discuss the frequency response of multistage amplifiers. Calculate the overall upper & lower cutoff frequencies.

3. Discuss the low frequency response & the high frequency response of an amplifier. Derive its cutoff frequencies.

4. Discuss the terms rise time and sag.

5. Write short notes on high frequency amplifier.

6. Derive the gain bandwidth for high frequency FET amplifiers.

7. Derive the expression for the CE short circuit current gain of transistor at high frequency.

8. What is the effect of Cb‘e on the input circuit of a BJT amplifier at High frequencies? Derive the equation for gm which gives the relation between gm, Ic and temperature.

9. Explain the high frequency analysis of JFET with necessary circuit diagram & gain bandwidth product.

10. Discuss the frequency response of MOSFET CS amplifier.

11. Determine the bandwidth of CE amplifier with the following specifications. R1=100kΩ, R2=10kΩ, RC=9kΩ, RE=2kΩ, C1= C2=25µF, CE=50µF, rbb‘=100Ω, rb‘e=1.1KΩ, hfe=225,Cb‘e=3Pf and Cb‘c=100pF.

12. At Ic=1mA & VCE=10v, a certain transistor data shows Cc=Cb‘c=3pF, hfe=200, & ωT=-500M rad/sec. Calculate gm, rb‘e, Ce=Cb‘e & ωβ.

13. Derive the expression of **Fβ & Fα**

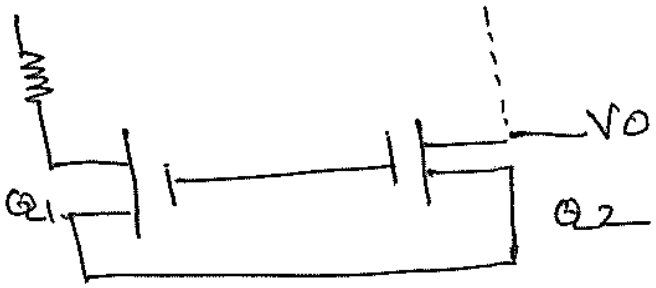
14. Derive the expression for CE short circuit gain using Hybrid π model

15. Explain the briefly the various stages of Multistage amplifiers

16. for the FET Amplifier the component value are Rd =2.2 K, Rl =4.7K Rg=10M,Rs=600cgd=2PF cgs=4PF gm=4ms. Determine high frequency of amplifier

UNIT V MOSFET AMPLIFIER

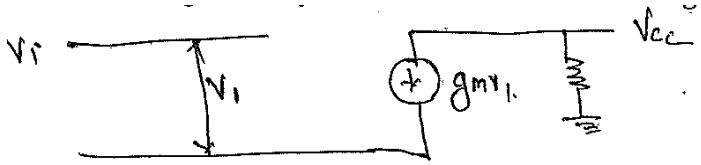
1) Draw the circuit for a basic MOSFET constant circuit source. (NOV 2014) (NOV 2015)



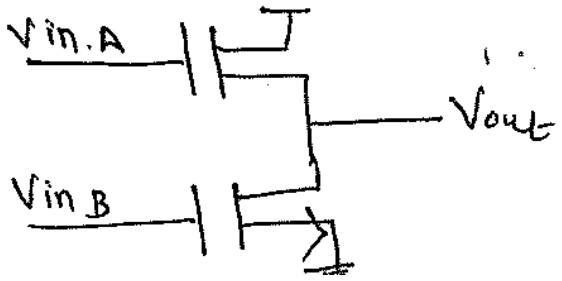
2) State the basic gain cell in Ic.

$$A_v = -g_m \cdot (r_{o1} \| r_{o2}).$$

3) Draw the small signal analysis circuit for determine voltage gain & Av.



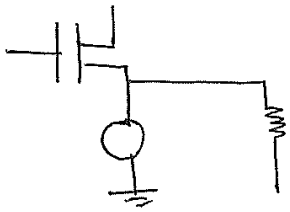
4) Draw the circuit design of PMOSFET CS Amplifier.



5) Why do we amplify a signal?

The signal is to small to due to load to overcome the noise of a subsequent stage we need to amplify the signal in order to obtain high f=gain factor

6) Draw the source follower amplifier circuit



$$A_{VSF} = \frac{R_L}{R_L + \frac{1}{g_m}}$$

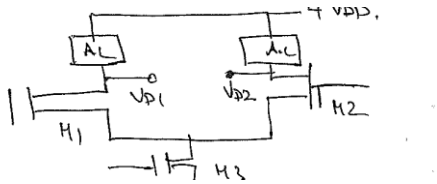
7) State the advantages of differential pair.

- Less sensitive to noise
- Bias is provided without need for by pass

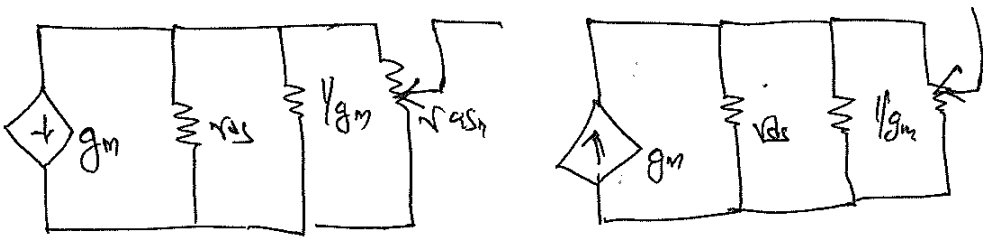
8) Define current steering. (APR 2017)

On an Ic Chip with a number of amplifier stages, a constant dc current is generated at one location and then replicated at various other locations for biasing the various amplifiers stages through a process known as current steering.

9) Draw the general MOS differential Amplifier



10) Draw the small signal mode of Differential amplifier.



11) What is the need of constant current in differential amplifier.

The necessary for constant current source for differential amplifier to increase the CMRR without changing quiescent current and without lowering the forward current gain.

12) List the application of MOSFET power amplifier.

. It is used in amplification process

13) What is distortion in power Amplifier?

In an ideal amplifier all frequency components of the signal amplifies proportionally hence the output signal is the exact repetition of the input signal.

14) Define active load and list the types of active load. (APR 2017) (NOV 2014) (APR 2015) (NOV 2015)

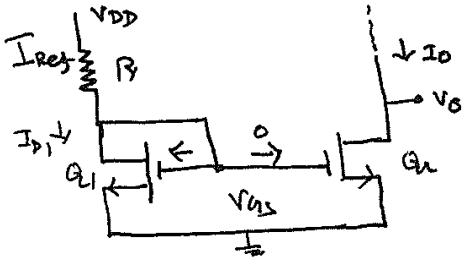
The MOS transistor used as a load device is referred to as active load. Three types of load devices are n- channel enhancement load device, n channel depletion load device and p channel enhancement load device.

15) State the advantages of current steering. (APR 2017)

Effort expended on generating a predictable and stable reference current usually utilizing a precision resistor external to the chip need not be repeated for every amplifier stage.

The bias currents of the various stages track each other in case of changes in power supply voltage or in temperature.

16) Draw the basic MOSFET constant current source.



17) Define voltage gain.

The ratio of output voltage to input voltage is called voltage gain Av of the amplifier
Av=V2/V1

18) List the features of Differential Amplifiers.

- High differential voltage gain
- Low common mode gain
- High CMRR
- Two input terminals
- High input impedance
- Large bandwidth

19) What are the other methods to improve CMRR without RE? (APR 2015)

- Constant current bias method
- Current mirror method

20) List the application of Differential Amplifier.

- Limiter
- Amplitude Modulation

PART – B (16 MARKS)

1. Describe the operation of an NMOS amplifier with either an enhancement load, a depletion load, or a PMOS load.

2. Explain the basic MOSFET two transistor current circuits and discuss its operation.

3. Draw the MOSFET Cascode current source circuit, explain and discuss the advantage of this design.

4. Sketch and describe the advantages of a MOSFET Cascode current source used with a MOSFET differential amplifier.

5. Design a CMOS differential amplifier with an output gain stage to meet a set of specifications. The magnitude of voltage gain of each stage is to be at least 600. Bias currents are to be IQ=IREF=100µA, and biasing of the circuit is to be V+=2.5 v and V-=2.5 v.

6. Explain CMOS differential amplifier and derive CMRR.

7. Draw a Widlar current source and explain the operation.

8. Describe the operation of a PMOS amplifier with an enhancement load, a depletion load.

9. Explain the CMOS common source and source follower with neat diagram.

10 .Explain the various current steering circuit used in MOSFET

11. Explain and derive the expression of Current of PMOS

12 .Explain with a neat diagram PMOS Current Source

13. Derive the parameter of NMOS Amplifier with active load in Enhancement mode

14. Derive the parameters of PMOS amplifier in depletion mode

15. Compare IC Biasing current steering circuit with differential amplifier

16. Calculate the coupling capacitor Cc required to provide a low frequency 3db p out at 125 H if Rs = 600,Fie=1K,hfe=60,R1=5K,R2=1.25K. For an ideal by pass capacitor a practical by pass capacitor Rce+25

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Question Paper Code : 97061

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2014.

Third Semester

Electronics and Communication Engineering

EC 6304 — ELECTRONIC CIRCUITS — I

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Find the collector and base current of circuit given in fig. 1. $h_{fe} = 100, V_{BE(on)} = 0.7V$.

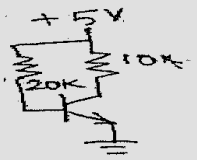


Fig.1.

2. What are the operating regions of N-Channel MOSFET and how do you identify the operating region?

3. Draw the ac equivalent circuit of figure 2.

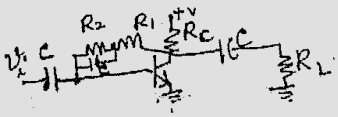


Fig.2.

4. Find CMRR of differential amplifier with differential gain of 300 and common mode gain of 0.2.

5. Draw small signal model of JFET.

6. What are the features of BiMOS cascode amplifier?

7. What is the effect of Millers capacitance on the frequency response of an amplifier?

8. Relate gain and bandwidth of single and multi-stage amplifier.

9. Draw a circuit of current source using MOSFET.

10. Draw a CMOS amplifier with NMOS driver and PMOS as active load.

PART B — (5 × 16 = 80 marks)

11. (a) (i) Design Emitter bias for BJT with $I_c = 2mA, V_{cc} = 18V, V_{CE} = 10\text{V}$ and $\beta = 150$.

(ii) Derive the stability factor of Self bias circuit of BJT.

Or

(b) Design voltage divider bias circuit for NMOS, such that $I_{DQ} = 400\mu A$, $V_{DD} = 14V$, $V_{DS} = 2.3V, k_n = \mu_n C_{ox}(W/L) = 1mA/V^2, V_t = 1V$. Assume a current of $1\mu A$ through R1 and R2, and Vs = 1.2 V.

12. (a) Derive CMRR of differential amplifier with its equivalent circuit.

Or

(b) Explain the operation of cascode amplifier and derive gain, input and output impedance.

13. (a) Derive gain, input and output impedance of common source JFET amplifier with neat circuit diagram and equivalent circuit.

Or

(b) Derive gain, input and output impedance of MOSFET source follower with neat circuit diagram and equivalent circuit.

14. (a) (i) Derive f_α, f_β and f_γ .

(ii) For the circuit shown in fig.3 find the cut-off frequencies due to C_1 and C_2.

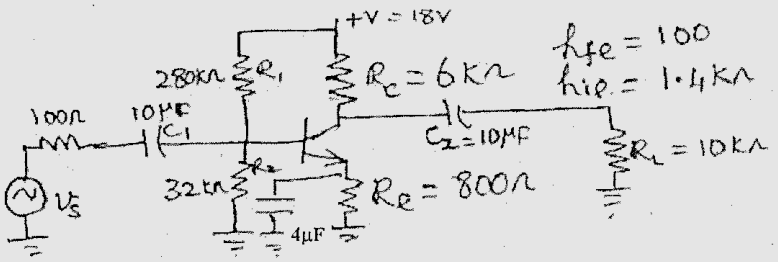


Fig.3.

Or

(b) Explain the high frequency operation of common source amplifier with its equivalent circuit.

15. (a) Draw a MOS current steering circuit with two sink and two source terminals. Write the expression for the terminal currents in terms of reference current.

Or

(b) Derive gain, input and output impedance of common source amplifier with NMOS diode connected active load.

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 77114

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2015.

Third Semester

Electronics and Communication Engineering

EC 6304 — ELECTRONIC CIRCUITS — I

(Regulation 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List out the importance of selecting the proper operating point.

2. Draw a DC load line of the circuit shown in Figure 1.

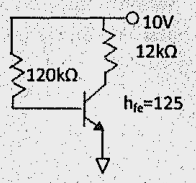


Figure 1

3. Define CMRR of BJT differential amplifier. How to improve it?

4. A small signal source $V_i(t) = 20\cos 20t + 30\sin 10^6 t$ is applied to a transistor amplifier as shown in Figure 2. The transistor has $h_{fe} = 150$, $r_0 = \infty$ and $r_\pi = 3\ \text{k}\Omega$. Determine $V_0(t)$.

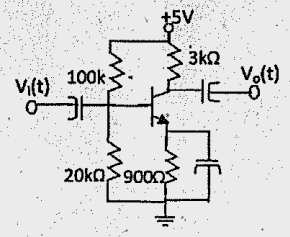


Figure 2

5. Determine the output impedance of a JFET amplifier shown in Figure 3. Let $g_m = 2$ mA/V and $\lambda = 0$.

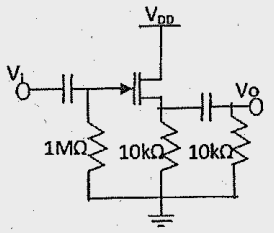


Figure 3

6. Compare between JFET and MOSFET amplifiers.

7. Find the unity gain bandwidth of MOSFET whose $g_m = 6$ mA/V, $C_{gs} = 8$ pF, $C_{gd} = 4$ pF and $C_{ds} = 1$ pF.

8. The ac schematic of an NMOS common-source stage is shown in the Figure-4, where part of the biasing circuits has been omitted for simplicity. For the N-channel MOSFET M_1, the transconductance, $g_m = 1$ mA/V, and body effect and channel length modulation effect are to be neglected. Find the lower cutoff frequency.

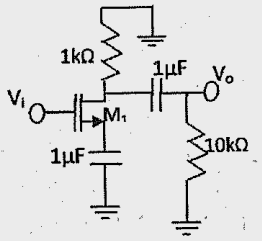


Figure-4

9. Compare NMOS amplifier with enhancement, depletion and resistive load.

10. List out the advantages of CMOS differential amplifier over MOS differential amplifier.

PART B — (5 × 16 = 80 marks)

11. (a) (i) The parameters for each transistor in the circuit in Figure-5, are $h_{fe} = 100$ and $V_{BE_{on}} = 0.7$ V. Determine the Q-point values of base, collector and emitter currents in Q_1 and Q_2. (8)

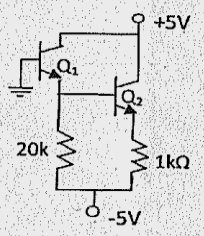


Figure 5

(ii) Determine the change in collector current produced in each bias referred to in Figures 6(a) and 6(b), when the circuit temperature raised from 25°C to 105°C and $I_{CBO} = 15$ nA @ 25°C. (8)

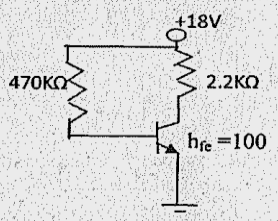


Figure 6(a)

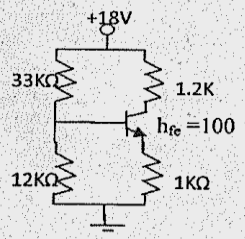


Figure 6(b)

Or

(b) (i) Determine the quiescent current and voltage values in a p-channel JFET circuit (Vide Figure-7). (6)

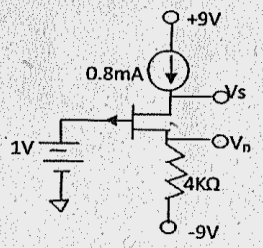


Figure-7

(ii) The circuit in Figure 8, let $h_{fe} = 100$. (1) Find V_{TH} and R_{TH} for the base circuit. (2) Determine I_{CQ} and V_{CEQ}. (3) Draw the DC load line. (10)

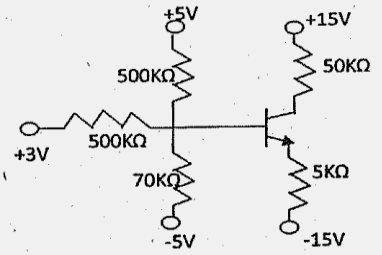


Figure 8

12. (a) (i) Consider the circuit shown in Figure-9 with the parameters are $h_{fe} = 120$ and $V_A = \infty$. (1) Determine the current gain, voltage gain, input impedance and output impedance. (2) Find the maximum undistorted output voltage swing. (12)

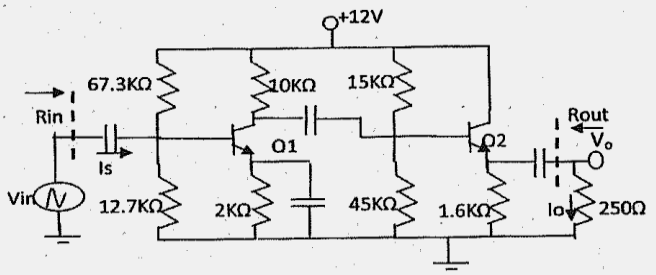


Figure 9

(ii) The parameters for each transistor in the circuit in Figure-10 are $h_{fe} = 100$, $V_A = \infty$ and $V_{BE(on)} = 0.7$ V. Determine the input and output impedances. (4)

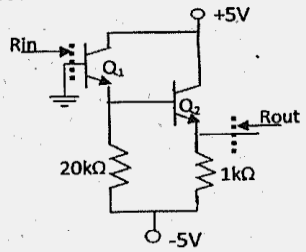


Figure 10

Or

(b) (i) For the circuit shown in Figure-11, the transistor parameters are $h_{fe} = 125$, $V_A = \infty$, $V_{CC} = 18$ V, $R_L = 4$ kΩ, $R_E = 3$ kΩ, $R_C = 4$ kΩ, $R_1 = 25.6$ kΩ and $R_2 = 10.4$ kΩ. The input signal is a current source. Determine its small signal voltage gain, current gain, maximum voltage gain and input impedance. (10)

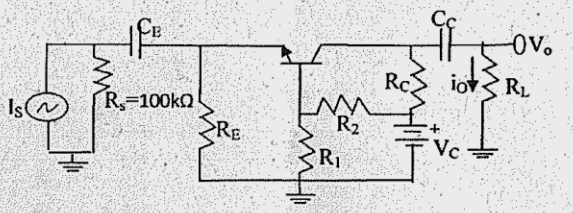


Figure 11

(ii) Draw the circuit diagram of bootstrapped emitter follower with its equivalent circuit, derive for its input and output impedance. (6)

13. (a) (i) Derive the voltage gain of BiMOS cascode amplifier shown in Figure 12. (10)

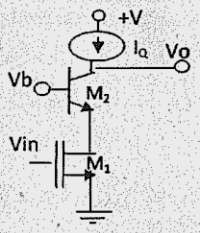


Figure 12

(ii) Draw a discrete common gate JFET amplifier and derive voltage gain, A_V, Input impedance, R_{in} and output impedance, R_{out} with small signal equivalent circuit. (6)

Or

(b) (i) Consider the PMOS amplifier shown in Figure-13. The transistor parameters are $V_{tp} = -1$ V, $\beta_p = (\mu_p Cox(W/L)) = 1$ mA/V^2 and $\lambda = 0$. (1) Determine R_D and R_S, such that $I_{DQ} = 0.75$ mA and

(b) (i) For the circuit shown in Figure-11, the transistor parameters are $h_{fe} = 125$, $V_A = \infty$, $V_{CC} = 18$ V, $R_L = 4$ kΩ, $R_E = 3$ kΩ, $R_C = 4$ kΩ, $R_1 = 25.6$ kΩ and $R_2 = 10.4$ kΩ. The input signal is a current source. Determine its small signal voltage gain, current gain, maximum voltage gain and input impedance. (10)

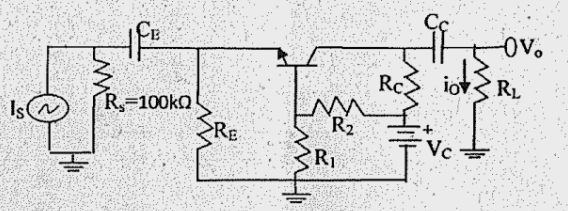


Figure 11

(ii) Draw the circuit diagram of bootstrapped emitter follower with its equivalent circuit, derive for its input and output impedance. (6)

13. (a) (i) Derive the voltage gain of BiMOS cascode amplifier shown in Figure 12. (10)

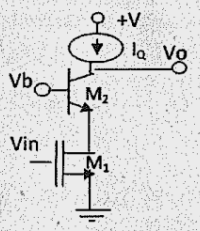


Figure 12

(ii) Draw a discrete common gate JFET amplifier and derive voltage gain, A_V, Input impedance, R_{in} and output impedance, R_{out} with small signal equivalent circuit. (6)

Or

(b) (i) Consider the PMOS amplifier shown in Figure-13. The transistor parameters are $V_{tp} = -1$ V, $\beta_p = (\mu_p Cox(W/L)) = 1$ mA/V^2 and $\lambda = 0$. (1) Determine R_D and R_S, such that $I_{DQ} = 0.75$ mA and

$V_{SDQ} = 6$ V. (2) Determine Input impedance R_i and Output impedance R_o. (3) Voltage gain, Current Gain and Maximum Output Voltage Swing. (12)

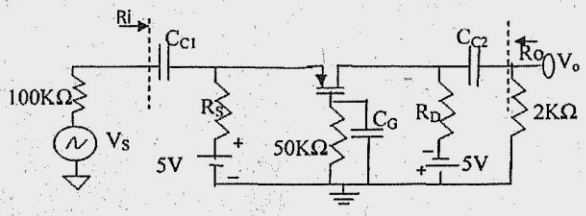


Figure-13

(ii) Determine the current gain of JFET source follower amplifier. (4)

14. (a) (i) For the circuit shown in Figure 14, let $V_{DD} = V_{SS} = 1.5$ V, $V_{tn} = 0.6$ V, $V_{tp} = -0.6$ V, all channel lengths = 1 μm, $K_n = 200\ \mu A/V^2$, $K_p = 80\ \mu A/V^2$ and $\lambda = 0$. For $I_{ref} = 10\ \mu A$, find the widths of all transistors to obtain $I_2 = 60\ \mu A$, $I_3 = 20\ \mu A$ and $I_5 = 80\ \mu A$. It is further required that the voltage at the drain of Q_2 be allowed to go down within 0.2 V of the negative supply and voltage at the drain of Q_5 be allowed to go up to within 0.2 V of the positive supply. (10)

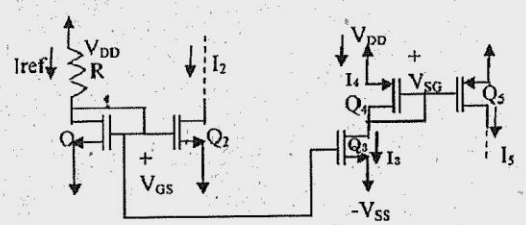


Figure-14

(ii) For the NMOS inverter circuit with saturated load (vide Figure-15), the transistor parameters are: (device data for M_D: $V_{tn_D} = 1$ V, $K_{n_D} = \mu_n Cox(W/L) = 100\ \mu A/V^2$, $\lambda_{n_D=0}$ and device data for M_L:

$V_{tn_L} = 1$ V, $K_{n_L} = \mu_n Cox(W/L) = 20\ \mu A/V^2$ and $\lambda_{n_L} = 0$). Draw its voltage-transfer characteristics curve, and mark down its transition points. (4)

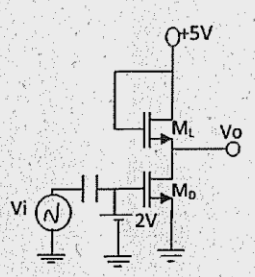


Figure-15

(iii) For CMOS differential amplifier with NMOS differential pair and PMOS current source as active load. Given $I_{DQ} = 500\ \mu A$, $(W/L)_{NMOS} = 5$, $\mu_n C_{ox} = 115\ \mu A/V^2$, $\mu_p C_{ox} = 30\ \mu A/V^2$, $\lambda_n = 0.01\ V^{-1}$, $\lambda_p = 0.02\ V^{-1}$. Find differential mode voltage gain. (2)

Or

(b) (i) Consider the circuit of NMOS amplifier with depletion load (Vide Figure-16). The transistor parameters are $V_{TND} = 0.8$ V, $V_{TNL} = -1.2$ V, $\beta_{nD} = (\mu_{nD} C_{ox}(W/L)) = 500\ \mu A/V^2$, $\beta_{nL} = (\mu_{nD} Cox(W/L)) = 50\ \mu A/V^2$, $I_{DQ} = 100\ \mu A$, $V_{DD} = 5$ V and $\lambda_{nD} = \lambda_{nL} = 0.01\ V^{-1}$. (1) Determine V_{GS} such that the Q-point is the mid of the saturation region. (2) Calculate Q-point drain current. (3) Determine the small signal voltage gain. (8)

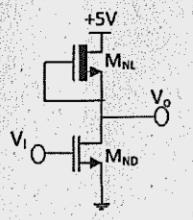


Figure-16

(ii) Determine the voltage gain, input impedance, output impedance of CMOS source follower amplifier. (8)

15. (a) (i) Derive for f_β and f_α. (6)

(ii) For the circuit shown in Figure-17 has following parameters: $h_{fe} = 125$, $C_\pi = 24$ pF, $C_\mu = 3$ pF. (1) Determine its mid-band gain, upper-cut off frequency. (2) Find the value of C_{C1}, C_{C2} and C_E by assuming lower cut-off frequency of 100 Hz. (10)

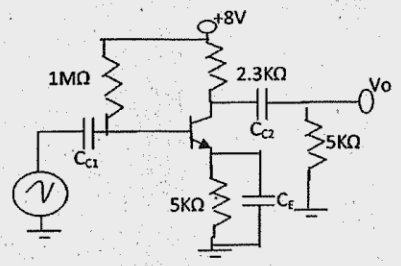


Figure-17

Or

(b) For the circuit shown in Figure-18, the NMOS transistor parameters are: $\mu_n Cox(W/L) = 2$ mA/V^2, $V_{GSQ} = 3.25$ V, $V_{tn} = 2$ V, $\lambda = 0$, $C_{gd} = 0.1$ pF and $C_{gs} = 1$ pF. Assume $C_G = C_D = C_S = 1$ pF. Calculate the mid-band gain, input impedance, output impedance, bandwidth and maximum output voltage swing. (16)

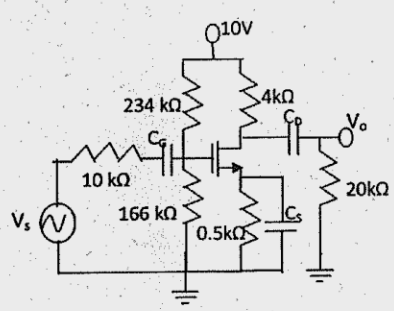


Figure-18

Reg. No. : | | | | | | | | | | | | |

Question Paper Code : 27191

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2015.

Third Semester

Electronics and Communication Engineering

EC 6304 — ELECTRONIC CIRCUITS — I

(Regulations 2013)

Time : Three hours | Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. Why is the operating point selected at the Centre of the active region?

2. Define Stability factor.

3. How are amplifiers classified according to the transistor configuration?

4. State Miller's Theorem.

5. Compare the features of three MOSFET amplifier configurations.

6. How does a transistor width-to-length ratio affect the small signal voltage gain of a common source amplifier?

7. Give relation between rise time and bandwidth.

8. Draw the hybrid π equivalent circuit of BJTs.

9. Mention the different types of active loads.

10. Draw a NMOS current source.

PART B — (5 × 16 = 80 marks)

11. (a) Why biasing is necessary in BJT amplifier? Explain the concept of DC & AC load line with neat diagram. How will you select the operating point, explain it using CE amplifier characteristics? (16)

Or

(b) Describe in detail the various types of bias compensation circuits with neat illustration. (16)

12. (a) Enumerate in detail and derive expression for voltage gain of CS and CD amplifier under small signal low frequency condition. (16)

Or

(b) Explain in detail the transfer characteristics of differential amplifier. Explain the methods used to improve CMRR. (16)

13. (a) Draw a common Gate MOSFET amplifier and derive for A_{VS}, A_{IS} and R_O using small signal equivalent circuit. (16)

Or

(b) Explain with circuit and equivalent circuit BIMOS Cascode amplifier. Also derive for G_M and R_O of the amplifier. (16)

14. (a) With neat sketch explain hybrid π CE transistor model. Derive the expression for various components in terms of 'h' parameters (16)

Or

(b) Explain the high frequency analysis of JFET with necessary circuit diagram and gain bandwidth product. (16)

15. (a) Discuss the operation of MOS differential amplifier with active and derive for CMRR. (16)

Or

(b) Explain in detail the operation of CMOS common source and source follower with neat diagram and derive for Av. (16)

Reg. No. [ ]

Question Paper Code : 80335

B.E./B.Tech. DEGREE EXAMINATION, NOVEMBER/DECEMBER 2016.

Third Semester

Electronics and Communication Engineering

EC 6304 – ELECTRONIC CIRCUITS - I

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. What is a Q point?

2. What is the impact of temperature on drain current of MOSFET?

3. What is an ac load line?

4. Draw the small-signal ac equivalent circuit of the BJT.

5. What is the impact of including a source resistor in the FET amplifier?

6. Why multi-stage amplifiers are required?

7. What is the reason for reduction in gain at lower and higher frequencies in case of amplifiers?

8. Determine the unity-gain bandwidth of a FET with parameters, Cgd = 10 fF, Cgs = 50 fF and g_m = 1.2 mA/V.

9. Why active loads are not used with discrete circuits?

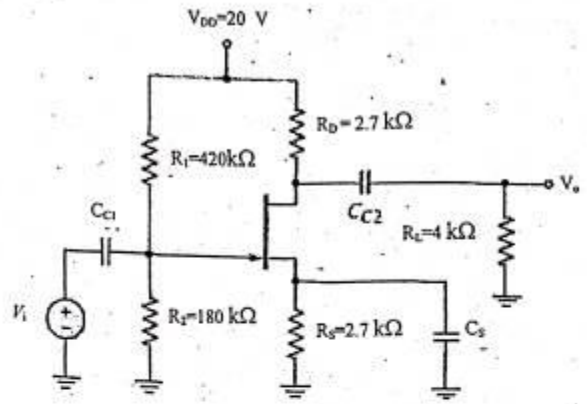
10. Define CMRR.

PART B — (5 × 13 = 65 marks)

11. (a) Analyze a BJT with a voltage divider bias circuit, and determine the change in the Q-point with a variation in β when the circuit contains an emitter resistor. Let the biasing resistors be R_{B1} =56 $k\Omega$, R_{B2}=12.2 kΩ, R_C= 2 KΩ, R_E = 0.4 kΩ, V_{CC} = 10 V, V_{BE}(on) = 0.7 V, and β =100.

Or

(b) Consider the circuit shown below with transistor parameters I_{DSS}=12 mA, V_P = –4V, and λ = 0.008 V^{-1}. Determine the small-signal voltage gain A_v = vo/vi.

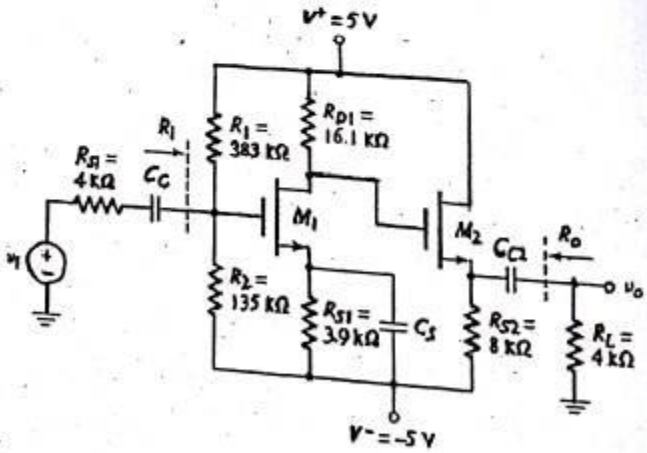


12. (a) Analyze a basic common-base amplifier circuit and derive the expressions for its small-signal voltage gain, current gain, input impedance and output impedance.

Or

(b) With neat diagrams, explain the operation and advantages of Darlington pair circuit. Also analyze its small-signal voltage gain and input impedance.

13. (a) Determine the small-signal voltage gain of a multistage cascade circuit shown in the figure below. The transistor parameters are K_{n1} = 0.5 mA/V², K_{n2} = 0.2 mA/V², V_{TN1}=V_{TN2}=1.2 V and $\lambda_1 = \lambda_2 = 0$. The quiescent drain currents are I_{D1} = 0. 2 mA and I_{D2} = 0.5 mA.



Or

(b) (i) Draw the circuit of a basic common source amplifier with voltage divider bias and derive the expressions for voltage gain, input impedance and output impedance using small-signal model. (8)

(ii) Determine the voltage gain of the circuit, assuming the following parameters: $V_{DD} = 3.3$ V, $R_D = 10\ k\Omega$, $R_{G1} = 140\ k\Omega$, $R_{G2} = 60\ k\Omega$, and $R_{Si} = 4\ k\Omega$. The transistor parameters are: $V_{TN} = 0.4$ V, $K_n = 0.5$ mA/V², and $\lambda = 0.02\ V^{-1}$. (5)

14. (a) Derive the expression for cut-off frequency of a BJT.

Or

(b) Construct the high frequency equivalent circuit of a MOSFET from its geometry and derive the expression for short circuit current gain in the common-source configuration.

15. (a) Draw and explain the operation of a simple MOSFET amplifier with active load and derive its voltage gain using small-signal equivalent circuit.

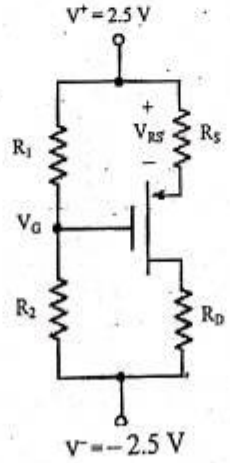
Or

(b) With necessary diagrams, explain the operation of a CMOS differential amplifier. Using small signal analysis, derive the expression for its voltage gain.

PART C — (1 × 15 = 15 marks)

(Application/Design/Analysis/Evaluation/Creativity/Case study)

16. (a) Design the circuit given below such that $I_{DQ} = 100\,\mu A$, $V_{SDQ} = 3V$, and $V_{RS} = 0.8\,V$. Note that V_{RS} is the voltage across the source resistor R_S. The value of the larger bias resistor, either R_1 or R_2 is to be 200 $k\Omega$. Transistor parameter values are $Kp = 100\,\mu A/V^2$ and $V_{TP} = -0.4\,V$. The conduction parameter, Kp may vary by ±5 percent.



Or

Reg. No. : [ ]

Question Paper Code : 71727

B.E./B.Tech. DEGREE EXAMINATION, APRIL/MAY 2017.

Third Semester

Electronics and Communication Engineering

EC 6304 – ELECTRONIC CIRCUITS – I

(Regulations 2013)

Time : Three hours

Maximum : 100 marks

Answer ALL questions.

PART A — (10 × 2 = 20 marks)

1. List out the three stability factor.

2. Find the collector and base current of circuit given in fig 2 hfe = 80, $V_{BE(ON)} = 0.7$ V.

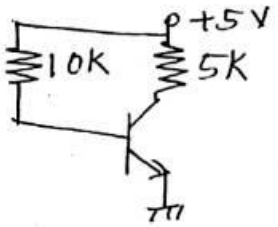


Fig. 2

3. State Miller's theorem.

4. Draw the small signal equivalent of CB configuration.

5. What are the features of BiMOS cascode amplifier?

6. What is the use of source bypass capacitor in CS amplifier?

7. Define rise time. Give the relationship between bandwidth and rise time.

8. Sketch hybrid π equivalent model of the BJT.

9. State the advantages of current steering circuit.

10. Define active load and list the types of active load.

PART B — (5 × 13 = 65 marks)

11. (a) Derive the stability factors for voltage divider bias circuit and give reason why it is advantageous than fixed bias circuit. (13)

Or

(b) (i) Draw a circuit which uses a diode to compensate for changes in I_{CO}. Explain how stabilization is achieved in the Circuit. (8)

(ii) Briefly explain the reason for keeping the operating point of a transistor as fixed. (5)

12. (a) Draw the a.c equivalent circuit of a CE amplifier with voltage divider bias and derive the expression for current gain, voltage gain, Input impedance, output admittance and overall current gain. (13)

Or

(b) Explain the operation of cascade amplifier and derive Voltage gain, overall input Resistance overall current gain and output impedance. (13)

13. (a) Derive gain, input and output impedance of common source JFET amplifier with neat diagram and equivalent circuit. (13)

Or

(b) Draw a common Gate MOSFET amplifier and derive for Av, Ai and Ri using small signal equivalent circuit.

14. (a) Determine the low frequency response of the amplifier circuit shown in Fig. 14 (a) Given data's (13)

$R_s = 680\ \Omega;\ R_1 = 68\ K\Omega; R_2 = 22\,K\Omega;\ \mathrm{Re} = 1K\ \ V_{cc} = 10\ V$

$C_1 = C_2 = 0.1\ \mu F;\ C_E = 10\ \mu F.$

$R_c = 2.2\ K\Omega;.\ R_L = 10\ K\Omega;; \beta = 100,\ hie = r\pi = 1.1k$

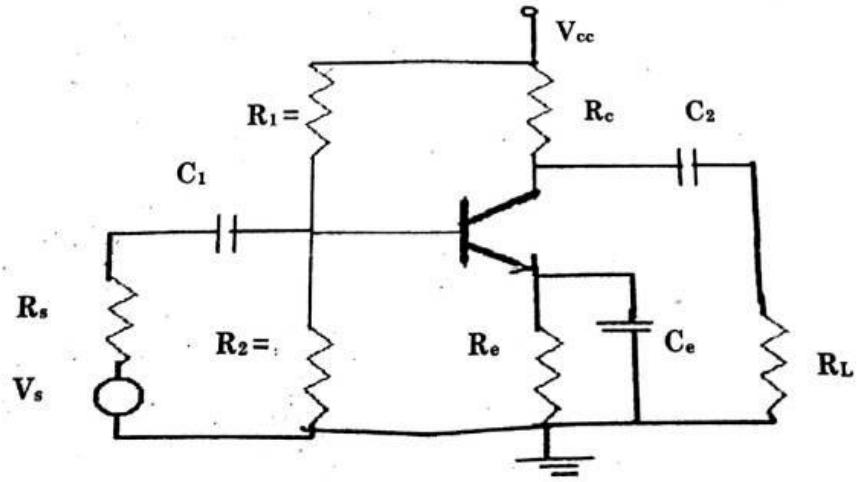


Fig. 14 (a)

Or

(b) Derive expressions for the short circuit current gain of common emitter amplifier at High Frequency. Define alpha cut-off frequency, beta cut-off frequency and transition frequency and derive their values in terms of the circuit parameters. (13)

15. (a) Explain the operation of MOS differential Amplifier with active load and derive for CMRR. (13)

Or

(b) (i) What is an IC biasing? Explain in detail about the MOSFET uses as a constant current source. (8)

(ii) With the analysis, explain about MOSFET current steering circuit. (5)

PART C — (1 × 15 = 15 marks)

16. (a) Find the Midband gain A_M and upper 3 — dB frequency f_H of a CS amplifier fed with a signal source having an internal resistance R_{sig} = 100 $K\Omega$. The Amplifier has RG = 4.7 MΩ, R_D = R_L =15 KΩ, g_m=1 mA/V, r_0=150 KΩ ,C_{gs} = 1pF and C_{gd} = 0.4pF. (15)

Or

(b) Calculate the input and output resistance of the emitter- follower circuit shown in Fig. 16 (b). Assume $R_s = 0.5\ k, r\pi = 3.28\ K\Omega, \beta = 100$ and $r_0 = 100\ K\Omega$.

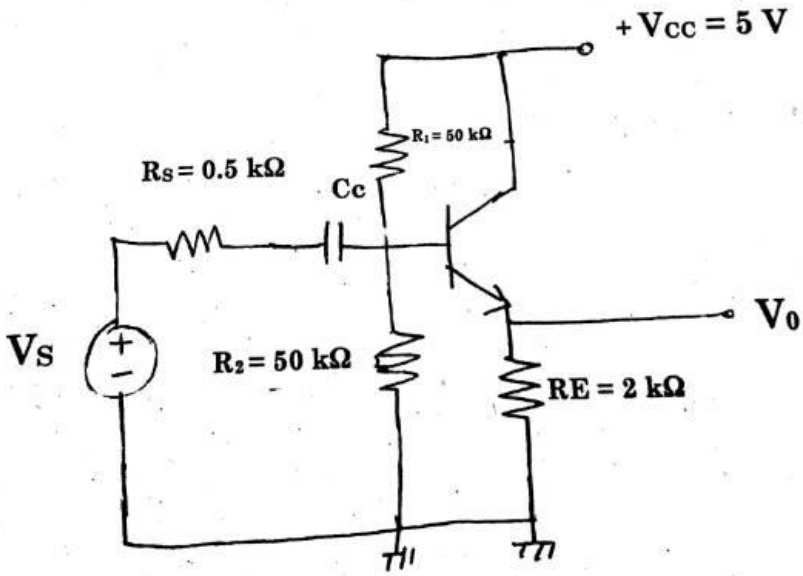


Fig. 16 (b)