CBCS SCHEME

USN ☐☐☐☐☐☐☐☐☐☐

BMATE/BEE301

Third Semester B.E./B.Tech. Degree Examination, Dec.2024/Jan.2025

Engineering Mathematics for EEE

Time: 3 hrs. Max. Marks: 100

Note: ***1. Answer any FIVE full questions, choosing ONE full question from each module.***
2. Use of statistical tables and mathematics formula handbook is permitted.
3. M : Marks , L: Bloom's level , C: Course outcomes.

<table>
<tr><th colspan="3">Module – 1</th><th>M</th><th>L</th><th>C</th></tr>
<tr><td>Q.1</td><td>a.</td><td>Solve: $(D^4 - 2D^3 + 5D^2 - 8D + 4)y = 0$</td><td>06</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>Solve: $(D^2 - 10D + 25)y = 2e^{5x} + \cos x + 5$</td><td>07</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>Solve: $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 2\log x$.</td><td>07</td><td>L3</td><td>CO1</td></tr>
<tr><th colspan="6">OR</th></tr>
<tr><td>Q.2</td><td>a.</td><td>Solve $(D^3 - 4D^2 + 5D - 2)y = 0$.</td><td>06</td><td>L2</td><td>CO1</td></tr>
<tr><td></td><td>b.</td><td>Solve $(1+x)^2y'' + (1+x)y' + y = 2\sin\log(1+x)$</td><td>07</td><td>L3</td><td>CO1</td></tr>
<tr><td></td><td>c.</td><td>In L-C-R circuit, the charge q on a plate of a consider is given by $L\frac{d^2q}{dt^2} + R\frac{dq}{dt} + \frac{q}{c} = E\sin pt$. The circuit is tuned to resonance so that $p^2 = \frac{1}{LC}$, if initially the current I and the charge q be zero, show that, for small values of R/L, the current in the circuit at time t is given by $\left(\frac{Et}{2L}\right)\sin pt$.</td><td>07</td><td>L3</td><td>CO1</td></tr>
<tr><th colspan="6">Module – 2</th></tr>
<tr><td>Q.3</td><td>a.</td><td>Fit a straight line y = ax + b in the Least Square Method to the following data:
<table>
<tr><td>x</td><td>50</td><td>70</td><td>100</td><td>120</td></tr>
<tr><td>y</td><td>12</td><td>15</td><td>21</td><td>25</td></tr>
</table></td><td>06</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>Find the correlation coefficient and hence find the regression lines for the data:
<table>
<tr><td>x</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td><td>7</td><td>8</td><td>9</td><td>10</td></tr>
<tr><td>y</td><td>10</td><td>12</td><td>16</td><td>28</td><td>25</td><td>36</td><td>41</td><td>49</td><td>40</td><td>50</td></tr>
</table></td><td>07</td><td>L3</td><td>CO2</td></tr>
<tr><td></td><td>c.</td><td>Given the equation of the regression lines x = 19.13 – 0.87y and y = 11.64 – 0.5x. Compute the mean of x's, mean of y's and the coefficient of correlation.</td><td>07</td><td>L3</td><td>CO2</td></tr>
<tr><th colspan="6">OR</th></tr>
<tr><td>Q.4</td><td>a.</td><td>Fit a parabola $y = ax^2 + bx + c$ by the method of least squares for the data:
<table>
<tr><td>x</td><td>2</td><td>4</td><td>6</td><td>8</td><td>10</td></tr>
<tr><td>y</td><td>3.07</td><td>12.85</td><td>31.47</td><td>57.38</td><td>91.29</td></tr>
</table></td><td>06</td><td>L2</td><td>CO2</td></tr>
<tr><td></td><td>b.</td><td>Obtain the lines of Regression and hence find the coefficient of correlation for the data:
<table>
<tr><td>x</td><td>1</td><td>3</td><td>4</td><td>2</td><td>5</td><td>8</td><td>9</td><td>10</td><td>13</td><td>15</td></tr>
<tr><td>y</td><td>8</td><td>6</td><td>10</td><td>8</td><td>12</td><td>16</td><td>16</td><td>10</td><td>32</td><td>32</td></tr>
</table></td><td>07</td><td>L3</td><td>CO2</td></tr>
</table>

c. The coefficient of rank correlation obtained by ten students in statistics and accountancy was 0.2. It was later discovered that the difference in ranks in the two subjects of one of the students was wrongly taken as 9 instead of 7. Find the correct rank correlation coefficient. **07** **L2** **CO2**

Module – 3

Q.5 **a.** Find the Fourier series for the function f(x) = |x| in $(-\pi, \pi)$ and hence deduce that $\frac{\pi^2}{8} = \sum_{n=1}^{\infty} \frac{1}{(2n-1)^2}$. **06** **L3** **CO3**

b. Obtain a Half Range Sine Series for the function **07** **L2** **CO3**

$$f(x) = \begin{cases} \frac{1}{4} - x & \text{for} \quad 0 \le x \le \frac{1}{2} \\ x - \frac{3}{4} & \text{for} \quad \frac{1}{2} \le x \le 1 \end{cases}$$

c. The following table gives the variations of a periodic current A over a period T. Show that there is a constant part of 0.75 Amp in the current A and obtain the amplitude of the first harmonic. **07** **L3** **CO3**

t (Secs)	0	T/6	T/3	T/2	2T/3	5T/6	T
A (Amp)	1.98	1.30	1.05	1.30	–0.88	–0.25	1.98

OR

Q.6 **a.** Expand the function $f(x) = x(2\pi - x)$ in the Fourier series over the internal $(0, 2\pi)$. **06** **L3** **CO3**

b. Find the half range cosine series for the function **07** **L2** **CO3**

$$f(x) = \begin{cases} x, & 0 < x \le \pi/2 \\ \pi - x & \pi/2 \le x < \pi \end{cases}$$

c. Express y as a Fourier series upto first harmonic for the following data: **07** **L3** **CO3**

x	0	1	2	3	4	5
y	9	18	24	28	26	20

Module – 4

Q.7 **a.** Find the Fourier transform of the function **06** **L3** **CO4**

$$f(x) = \begin{cases} 1 & \text{for} \quad |x| \le a \\ 0 & \text{for} \quad |x| > a \end{cases}$$

and hence evaluate $\int_0^{\infty} \frac{\sin x}{x} dx$

b. Find the Fourier sine transform of $\frac{e^{-ax}}{x}$, $a > 0$ **07** **L2** **CO4**

c. Find the Z – transform of $\cos\left(\frac{n\pi}{2} + \frac{\pi}{4}\right)$. **07** **L2** **CO4**

OR

Q.8 **a.** Find the Fourier transform of $f(x) = e^{-|x|}$. **06** **L2** **CO4**

b. Find the inverse Z-transform of $\frac{z^2}{(z-1)(z+3)}$ **07** **L2** **CO4**

c. Solve the difference equation $y_{n+2} - 4y_n = 0$, given that $y_0 = 0$ and $y_1 = 2$. **07** **L3** **CO4**

<table>
<tr><td colspan="6" align="center">Module – 5</td></tr>
<tr><td></td><td></td><td>The probability density function of a variable x is given by the following table:
<table><tr><td>x</td><td>0</td><td>1</td><td>2</td><td>3</td><td>4</td><td>5</td><td>6</td></tr><tr><td>p(x)</td><td>K</td><td>3K</td><td>5K</td><td>7K</td><td>9K</td><td>11K</td><td>13K</td></tr></table>for what value of K this represents a valid probability distribution? Also find $P(x \geq 5)$ and $P(3 < x \leq 6)$.</td><td>06</td><td>L2</td><td>CO5</td></tr>
<tr><td></td><td>b.</td><td>If the mean and standard deviation of the number of correctly answered questions in a test given to 4096 students are 2.5 and $\sqrt{1.875}$. Find an estimate number of candidates answering correctly:
(i) 8 or more questions (ii) 2 or less (iii) 5 questions</td><td>07</td><td>L3</td><td>CO5</td></tr>
<tr><td></td><td>c.</td><td>In a normal distribution 31% of the items are under 45 and 8% of the items are over 64. Find the mean and standard deviation of the distribution.</td><td>07</td><td>L3</td><td>CO5</td></tr>
<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>Q.10</td><td>a.</td><td>Explain the terms:
(i) Type I and Type II error
(ii) Alternative hypothesis
(iii) Significance level</td><td>06</td><td>L1</td><td>CO5</td></tr>
<tr><td></td><td>b.</td><td>A certain stimulus administered to each of the 12 patients resulted in the following change in blood pressure 5, 2, 8, –1, 3, 0, 6, –2, 1, 5, 0, 4. Can it be concluded that the stimulus will increase the blood pressure. $[t_{0.05}(11) = 2.201]$</td><td>07</td><td>L3</td><td>CO5</td></tr>
<tr><td></td><td>c.</td><td>4 coins are tossed 100 times and the following results were obtained. Fit a binomial distribution for the data and test the goodness of fit. $[\chi^2_{0.05} = 9.49]$</td><td>07</td><td>L3</td><td>CO5</td></tr>
</table>

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AY: 2024-25

Department:Electrical &Electronics Engineering
Subject with Sub. Code:Mathematics III for EE Stream(BMATE301)
Semester/Division/Branch:III/EE
Name of Faculty: Prof. Akshata B Patil.

Q.No.	Solution and Scheme	Marks
	MODULE-01.	
Q 1a.	$[D^4-2D^3+5D^2-8D+4]y=0$	
	A.E is	(1)
	$m^4-2m^3+5m^2-8m+4=0$	
	If $m=1$ is a repeated root (multiplicity 2)	(2)
	Divide the polynomial by $(m-1)^2=m^2-2m+1$ to	(1)
	get $m^2+4=0$ solving we get $m=\pm 2i$	
	The general sol^n is,	(2)
	$y=(c_1+c_2x)e^x+c_3\cos 2x+c_4\sin 2x$.	
		6M
1b.	$(D^2-10D+25)y=2e^{5x}+\cos x+5$.	
	A.E is	(1)
	$m^2-10m+25=0$	
	The factored as $(m-5)^2=0$	
	The roots are $m=5,5$	
	The C.F is	(1)
	$y=(c_1+c_2x)e^{5x}$	
	P.I	
	$\frac{2e^{5x}+\cos x+5}{f(D)}$	
	Let,	(2)
	$P_1=\frac{ke^{5x}}{D^2-10D+25}=\frac{2e^{5x}}{(5)^2-10(5)+25}=[D=0]$	
	$P_1=\frac{2e^{5x}}{2D-10}$ again $[D=0]$	
	$P_1=\frac{2e^{5x}}{2}=1$.	

Q.No.	Solution and Scheme	Marks
	$P_2 = \frac{\cos x}{D^2-10D+25}$ $[-a^2 = D^2]$ $\therefore P_2 = \frac{\cos x}{-1-10D+25} = \frac{\cos x}{(24-10D)} \times \frac{24+10D}{(24+10D)}$ $P_2 = \frac{24\cos x + 10(-\sin x)}{(24)^2 - 100D^2} = \frac{24\cos x - 10\sin x}{576-100D^2}$ $P_2 = \frac{24\cos x}{576-100(-1)} - \frac{10\sin x}{576-100(-1)}$ $= \frac{24\cos x}{576+100} - \frac{10\sin x}{576+100} \Rightarrow \frac{24\cos x}{676} - \frac{10\sin x}{676}$. $P_2 = \frac{24\cos x - 10\sin x}{676}$ $P_3 = \frac{1}{D^2-10D+25} \times 5 \Rightarrow \frac{5}{25} = 1/5$ G, S is, $y = CF + PI$ $= (C_1 + C_2x)e^{5x} + x^2e^{5x} + \frac{6\cos(x)}{169} + \frac{5\sin x}{169} + 1/5$	(2) (1) 7M
1c.	Let, $x = e^z$ $\therefore$ $z = \log x$. The eqn is $x^2\frac{d^2y}{dx^2} - x\frac{dy}{dx} + y = 2\log x$ $D(D-1)y - Dy + y = 2z$ $D^2y - Dy - Dy + y = 2z$ $D^2y - 2Dy + y = 2z$ A.E is $m^2 - 2m + 1 = 0$ $(m-1)^2 = 0 \Rightarrow m = 1, 1$	(1) (1)

C.F is

$(C_1 + C_2 z) e^{z}$ (1)

P.I

$P_I = \frac{1}{D^2 - 2D + 1} 2z \Rightarrow 2 \times \frac{1}{(D-1)^2} z$ (2)

$PI = 2z + 4$

General solution is,

$y = CF + PI$ (2)

$(C_1 + C_2 z) e^{z} + 2z + 4$

Therefore the D.E is

$y = [C_1 + C_2 \log(x)]x + 2\log(x) + 4.$

7M

2a $(D^3 - 4D^2 + 5D - 2)y = 0$

A.E is

$m^3 - 4m^2 + 5m - 2 = 0$ (1)

m=1 is a root by inspection method. let us find out the other roots.

$$\begin{array}{r|rrrr} 1 & 1 & -4 & 5 & -2 \\ & & 1 & -3 & 2 \\ \hline & 1 & -3 & 2 & 0 \end{array}$$ (2)

$\therefore m^2 - 3m + 2 = 0 \Rightarrow (m-2)(m-1) = 0$

$\therefore m = 1, 2$ (2)

Thus the roots are $m = 1, 1, 2$

C.F is

$y = (C_1 + C_2 x) e^{x} + C_3 e^{2x}$ (1)

Therefore the G.S is,

$y = (C_1 + C_2 x) e^{x} + C_3 e^{2x}.$

6M

2b. $(1+x)^2 y'' + (1+x)\frac{dy}{dx} + y = 2\sin[\log(1+x)]$

Put $t = \log(1+x)$ or $e^t = 1+x$ (1)

$(1+x)\frac{dy}{dx} = 1.Dy$, $(1+x)^2\frac{d^2y}{dx^2} = 1.D(D-1)y$

Hence the given DE becomes, (2)

$[D(D-1)+D+1]y = \sin 2t$ (1)

$(D^2+1)y = \sin 2t$

AE $m^2+1=0 \Rightarrow m = \pm i$ (1)

$y_c = c_1\cos t + c_2\sin t$ (1)

$y_p = \frac{\sin 2t}{D^2+1} = \frac{\sin 2t}{-2^2+1} = -\frac{\sin 2t}{3}$ (1)

Complete solution is,

$y = y_c + y_p$ 7M

$y = c_1\cos[\log(1+x)] + c_2\sin[\log(1+x)] - \frac{\sin 2[\log(1+x)]}{3}$.

2c] $L\left(\frac{d^2q}{dt^2}\right) + R\left(\frac{dq}{dt}\right) + q/C = E\sin(pt)$

Using $p^2 = 1/LC$ so $1/C = Lp^2$

$L\left(\frac{d^2q}{dt^2}\right) + R\left(\frac{dq}{dt}\right) + Lp^2q = E\sin(pt)$ (1)

Dividing by, L

~~t~~$(d^2q/dt^2) + (R/L)\left(\frac{dq}{dt}\right) + p^2q = (E/L)\sin(pt)$

C.F

$\left(\frac{d^2q}{dt^2}\right) + (R/L)\left(\frac{dq}{dt}\right) + p^2q = 0$ (2)

$D^2 + (R/L)D + p^2q = 0$

R/L is very small compared to $4p^2$.

roots are +/- ip.

C.F is (2)

$C_1\cos(pt) + C_2\sin(pt)$

P.I : solve the D.E and
Let us take the ~~imgua~~ imaginary part

Let us Assume $PI = Ae^{ipt}$
where A is complex constant.

$$\frac{dq}{dt} = ipAe^{ipt}$$

$$\frac{d^2q}{dt^2} = -p^2A.e^{ipt}$$

Substitute in the equation

$$-p^2Ae^{ipt} + (R/L)(ipAe^{ipt}) + p^2Ae^{ipt} = (E/L)e^{ipt}$$

Take the imaginary component the complete sol^n is

$$q(t) = CF + PI$$

$$q(t) = C_1\cos(pt) + C_2\sin(pt) + (-E/Rp)\cos(pt)$$

$$I(t) = dq/dt = p(C_2\cos(pt) - C_1\sin(pt)) + (E/L)\sin(pt)$$ (2)

General sol^n is,

$$q(t) = C_1\cos(pt) + C_2\sin(pt) - (E/Rp)\cos(pt)$$

$$I(t) = dq/dt = (C_2p + Et/2L)\cos(pt) - (C_1p)\sin(pt)$$

If,

$I(0) = 0$ therefore $C_2 = 0$

$q(0) = 0$ "

$I(0) = C_1 - E/Rp = 0$

∴ The current $I(t)$ at time t is given by $I(t)$

$= (Et/2L)\sin(pt)$. 7M

MODULE - 2

3a. Let $y = ax+b$ be the eq^n of the best fitting st line. (1)

The normal equations are

$\Sigma y = a\Sigma x + nb$ $(n=4)$

$\Sigma xy = a\Sigma x^2 + b\Sigma x$

x	y	xy	x^2
50	12	600	2500
70	15	1050	4900
100	21	2100	10,000
120	25	3000	14400
$\Sigma x = 340$	$\Sigma y = 73$	$\Sigma xy = 6750$	$\Sigma x^2 = 31800$

(2)

The normal equations becomes

$340a + 46b = 73$

$31800a + 340b = 6750$ } solving (2)

we get,

$a = 0.18793$; $b = 2.27586$ (1)

$a \simeq 0.19$; $b = 2.28$

The eqn of the st line is, 6M

$y = 0.19x + 2.28$.

3b. we prepare the table below,

x	y	$z = x - y$	x^2	y^2	z^2
1	10	−9	1	100	81
2	12	−10	4	144	100
3	16	−13	9	256	169
4	28	−24	16	784	576
5	25	−20	25	625	400
6	36	−30	36	1296	900
7	41	−34	49	1681	1156
8	49	−41	64	2401	1681
9	40	−31	81	1600	961
10	50	−40	100	2500	1600
$\Sigma x = 55$	$\Sigma y = 307$	$\Sigma z = -252$	$\Sigma x^2 = 385$	$\Sigma y^2 = 11387$	$\Sigma z^2 = 7624$

(2)

$\bar{x} = \frac{55}{10} = 5.5$, $\bar{y} = \frac{307}{10} = 30.7$, $\bar{z} = \frac{-252}{10} = -25.2$ (1)

$\sigma^2_x = \frac{\Sigma x^2}{n} - (\bar{x})^2 = \frac{385}{10} - (5.5)^2 = 8.25 \Rightarrow \sigma_x = 2.87$ (1)

$\sigma^2_y = \frac{\Sigma y^2}{n} - (\bar{y})^2 = 1138.7 - (30.7)^2 = 196.21 \Rightarrow \sigma_y = 14.01$ (1)

$\sigma^2_z = \sigma^2_{x-y} = \frac{\Sigma z^2}{n} - (\bar{z})^2 = 7624 - (-25.2)^2 = 127.36.$ (1)

$$r = \frac{\sigma^2_x+\sigma^2_y-\sigma^2_{x-y}}{2\sigma_x\sigma_y} = \frac{8.25+196.21-127.36}{2\times 2.87\times 14.01} = 0.96.$$

$\boxed{r = 0.96}$ (1)

Equation of the lines of regression are,

$y-\bar{y} = \frac{r\sigma_y}{\sigma_x}(x-\bar{x})$; $(x-\bar{x}) = r\frac{\sigma_x}{\sigma_y}(y-\bar{y})$ 7M

substituting,

$y = 4.686x + 4.927$ and $x = 0.197y - 0.548$

3c) we have to compute $\bar{x}, \bar{y}$ and r.

we know that the regression lines passes through $(\bar{x}, \bar{y})$ (1)

$\therefore \bar{x} = 19.13 - 0.87\bar{y}$ and $\bar{y} = 11.64 - 0.5\bar{x}$ (1)

$\bar{x} + 0.87\bar{y} = 19.13$ —— ① (1)

$0.5\bar{x} + \bar{y} = 11.64$ —— ②

we have to solve ① & ②

$\bar{x} = 15.94$ and $\bar{y} = 3.67$ (2)

w.k.T

$r = \sqrt{(\text{coeff of } x)(\text{coeff of } y)}$

$r = \sqrt{(-0.5)(-0.87)} = \pm 0.66$ (2)

We must take the sign of r to be negative

Thus,

$\bar{x} = 15.94$, $\bar{y} = 3.67$, $r = -0.66$. 7M

4a) The normal equations associated with $y = ax^2+bx+c$ are, (1)

$\Sigma y = a\Sigma x^2 + b\Sigma x + nC$

$\Sigma xy = a\Sigma x^3 + b\Sigma x^2 + C\Sigma x$

$\Sigma x^2 y = a\Sigma x^4 + b\Sigma x^3 + C\Sigma x^2$ $(n=5)$

The relevant table is prepared as below.

x	y	xy	x^2y	x^2	x^3	x^4
2	3.07	6.14	12.28	4	8	16
4	12.85	51.40	205.60	16	64	236
6	31.47	188.82	1132.92	36	216	1296
8	57.38	459.04	3672.32	64	512	4096
10	91.29	912.90	9129.00	100	1000	10000
$\Sigma x=30$	$\Sigma y=196.06$	Σxy $=1618.3$	Σx^2y $=14152.12$	Σx^2 $=220$	Σx^3 $=1800$	Σx^4 $=15664$

(2)

The normal equations become. (2)

$$\left.\begin{array}{l} 220a+30b+5c=196.06 \\ 1800a+220b+30c=1618.3 \\ 15664a+1800b+220c=14152.12 \end{array}\right\} \text{solving}$$

(1)

we get,

$a=0.99196$; $b=-0.85507$, $c=0.696$ 6M

Thus the required parabola is

$y=0.992x^2-0.855x+0.696.$

4b.

x	y	x^2	y^2	xy
1	8	1	64	8
3	6	9	36	18
4	10	16	100	40
2	8	4.	64	16
5	12	25	144	60
8	16	64	256	128
9	16	81	256	144
10	10	100	100	100
13	32	169	1024	416
15	32	225	1024	480
Σx $=70$	Σy $=150$	Σx^2 $=$ ~~694~~ 204	Σy^2 818	Σxy $=360.$

(2)

$y-\bar{y} = \frac{\Sigma XY}{204}(x-\bar{x}) \Rightarrow y-15 = 1.76(x-7)$ (2)

$\Rightarrow y = 1.76x + 2.68$

(2)

$x-\bar{x} = \frac{\Sigma xy}{\Sigma X^2}(y-\bar{y}) \Rightarrow (x-7) = 0.44(y-15)$

$\Rightarrow x = 0.44y + 0.4$

(1)

$r = \sqrt{(1.76)(0.44)}$

$r = 0.88.$ 7M

4c. we have,

$\rho = 1 - \frac{6\Sigma d^2}{n(n^2-1)}$ (1)

here, (1)
$n = 10$ and $\rho = 0.2$

Hence,
$0.2 = 1 - \frac{6\Sigma d^2}{10(10^2-1)}$ or $\frac{6\Sigma d^2}{990} = 1-0.2 = 0.8$ (2)

$\therefore \Sigma d^2 = \frac{990 \times 0.8}{6} = 132$

(2)

Now,
$\Sigma d^2 = 132 - 9^2 + 7^2 = 100$ (1)

$\therefore \rho = 1 - \frac{6(100)}{10(10^2-1)} = 0.394$ 7M

Thus,
$\rho = 0.394.$

MODULE - 03.

5a) $f(x) = |x|$ in $-\pi \le x \le \pi$

$$f(x) = \begin{cases} -x & \text{in } -\pi \le x \le 0 \\ +x & \text{in } 0 \le x \le \pi \end{cases}$$

The Fourier Series of f(x) having period 2π is given by (1)

$f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos nx + \sum_{n=1}^{\infty} b_n \sin nx$ - - - - - ①

here f(x) is even function so $\boxed{b_n = 0}$

$a_0 = 2/\pi \int_0^{\pi} f(x)\,dx$; $a_n = 2/\pi \int_0^{\pi} f(x) \cos nx\,dx.$ (1)

Here,

$f(x) = |x| = x$ for $x \in (0, \pi)$

$a_0 = 2/\pi \int_0^\pi x\,dx = 2/\pi \left[\frac{x^2}{2}\right]_0^\pi = \frac{1}{\pi}(\pi^2 - 0) = \pi$ (1)

$\therefore \frac{a_0}{2} = \pi/2$

$a_n = 2/\pi \int_0^\pi x \cos nx\,dx$

Applying Bernoullis rule

$a_n = 2/\pi \left[x\left(\frac{\sin nx}{n}\right) - (1)\left(-\frac{\cos nx}{n^2}\right)\right]_0^\pi$ (2)

$= \frac{2}{\pi n^2}\left[\cos nx\right]_0^\pi$, since $\sin n\pi = 0 = \sin 0$

$= \frac{2}{\pi n^2}(\cos n\pi - \cos 0) = \frac{2}{\pi n^2}(\cos n\pi - 1) = \frac{-2}{\pi n^2}(1 - \cos n\pi)$

$a_n = \frac{-2}{\pi n^2}\{1 - (-1)^n\}$ 1

substituting the value of a_0, a_n, b_n in eqn ⓪ 6M

$f(x) = \frac{\pi}{2} + \sum_{n=1}^{\infty} \frac{-2}{\pi n^2}\{1 - (-1)^n\} \cos nx.$

5b] $f(x)$ is defined in $(0,1)$ comparing with $(0, l)$

we have $l = 1$

The half range sine series is given by,

$f(x) = \sum_{n=1}^{\infty} b_n \sin n\pi x$ where, $b_n = 2\int_0^1 f(x) \sin n\pi x\,dx$ (1)

$b_n = 2\left\{\int_0^{1/2}\left(\frac{1}{4} - x\right)\sin n\pi x\,dx + \int_{1/2}^{1}(x - 3/4)\sin n\pi x\,dx\right\}$ (1)

Applying Bernoullis rule to each of the integrals.

$b_n = 2\left\{\left[\left(\frac{1}{4} - x\right) \cdot \frac{-\cos n\pi x}{n\pi} - (-1) \cdot \frac{-\sin n\pi x}{n^2\pi^2}\right]_0^{1/2}\right.$

$\left. + \left[(x - 3/4) \cdot \frac{-\cos n\pi x}{n\pi} - 1 \cdot \frac{-\sin n\pi x}{n^2\pi^2}\right]_{1/2}^{1}\right\}$ (2)

$= 2\left\{\frac{-1}{n\pi}\left[\left(\frac{1}{4} - x\right)\cos n\pi x\right]_0^{1/2} - \frac{1}{n^2\pi^2}\left[\sin n\pi x\right]_0^{1/2} - \frac{1}{n\pi}\left[(x - 3/4)\cos n\pi x\right]_{1/2}^{1}\right.$

$\left. + \frac{1}{n^2\pi^2}\left[\sin n\pi x\right]_{1/2}^{1}\right\}$

$= 2\left\{\frac{1}{4n\pi}\left(\cos\frac{n\pi}{2} + 1 - \cos n\pi - \cos\frac{n\pi}{2}\right) - \frac{2}{n^2\pi^2}\sin\frac{n\pi}{2}\right\}$

$= 2\left\{\frac{1}{4n\pi}\left(1 - \cos n\pi\right) - \frac{2}{n^2\pi^2}\sin\frac{n\pi}{2}\right\}$ (2)

$b_n = \frac{1}{2n\pi}\{1-(-1)^n\} - \frac{4}{n^2\pi^2}\sin\frac{n\pi}{2}$.

Thus the sine half range series is given by 1

$f(x) = \sum_{n=1}^{\infty}\left[\frac{1}{2n\pi}\{1-(-1)^n\} - \frac{4}{n^2\pi^2}\sin\frac{n\pi}{2}\right]\sin n\pi x.$ 7M

5c] A periodic function can be represented as a sum of Sine & cosine functions.

The general form is,

$A(t) = \frac{a_0}{2} + \sum[a_n\cos(n\omega t) + b_n\sin(n\omega t)]$ (1)

$\frac{a_0}{2} = 0.75$ A. This is already given in question

there is a constant part of 0.75 A'

Let us calculate first harmonic.

$Wt = 2\times 3.14/T$

$a_1 = (2/7)(1.98\cos(0)) + 1.30\cos(30) + 1.05\cos(60)$ (2)
$-0.25\cos(150) + 1.98\cos(180)$
$+ 1.30\cos(90) - 0.88\times\cos(120) - 0.25\cos(150) + 1.98\cos(180)$
$+1.30\cos(90) - 0.88\times\cos(120)$

$a_1 = (2/7)(1.98 + 1.12 - 0.14 + 0.44 + 0.22 - 1.98) = 0.271$

$b_1 = (2/T)(\int A(t)\sin(Wt)dt.$

$b_1 = (2/7)(1.98\sin(0) + 1.30\sin(30) + 1.05\sin(60) + 1.30\sin(90)$ (2)
$+ 1.98\sin(180))$
$-0.88\sin(120) - 0.25\sin(150) + 1.98\sin(180))$

$= (2/7)(0.65 + 0.91 + 1.3 - 0.76 - 0.125) = 0.564$

The first harmonic is,

$A = 0.271^2 + 0.564^2 = 0.626$ (2)

Thus,

* The constant part DC component of the current is 0.75 A.

* The Amplitude of the first harmonic is Approx 0.626 A. 7M

6a The Fourier Series of $f(x)$ having period 2π is given by

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}a_n\cos nx+\sum_{n=1}^{\infty}b_n\sin nx \quad ------ ①$$

Now,

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

(2

$$a_0=\frac{1}{\pi}\left[\pi x^2-x^3/3\right]_0^{2\pi}=\frac{1}{\pi}\left[4\pi^3-\frac{8\pi^3}{3}\right]=\frac{4\pi^2}{3}$$

$$\frac{a_0}{2}=2\pi^2/3$$

$$a_n=\frac{1}{\pi}\int_0^{2\pi}f(x)\cos nx\,dx=\frac{1}{\pi}\int_0^{2\pi}(2\pi x-x^2)\cos nx\,dx$$

$$a_n=\frac{1}{\pi}\left[(2\pi x-x^2)\left(\frac{\sin nx}{n}\right)-(2\pi-2x)\left(\frac{-\cos nx}{n^2}\right)+(-2)\left(\frac{-\sin nx}{n^3}\right)\right]_0^{2\pi}$$ (2)

$$=\frac{1}{\pi n^2}\left(-2\pi\cos 2n\pi-2\pi\cos 0\right)$$

$$a_n=-4/n^2$$

$$b_n=\frac{1}{\pi}\int_0^{2\pi}f(x)\sin nx\,dx=\frac{1}{\pi}\int_0^{2\pi}(2\pi x-x^2)\sin nx\,dx$$

(2

$$b_n=\frac{1}{\pi}\left[(2\pi x-x^2)\left(\frac{-\cos nx}{n}\right)-(2\pi-2x)\left(\frac{-\sin nx}{n^2}\right)+(-2)\left(\frac{\cos nx}{n^3}\right)\right]_0^{2\pi}$$

$$b_n=\frac{-2}{\pi n^3}(1-1)=0$$

$$b_n=0$$

substituting all the values in eqn ①

$$f(x)=2\pi x-x^2=\frac{2\pi^2}{3}+\sum_{n=1}^{\infty}\frac{-4}{n^2}\cos nx$$

6M

6b The cosine half range F.S of $f(x)$ in $(0,\pi)$ is given by,

$$f(x)=\frac{a_0}{2}+\sum_{n=1}^{\infty}a_n\cos nx$$

(1)

where,

$$a_0=\frac{2}{\pi}\int_0^{\pi}f(x)\,dx \quad ; \quad a_n=\frac{2}{\pi}\int_0^{\pi}f(x)\cos nx\,dx$$

6c. The values at 0, 1, 2, 3, 4, 5 are given (N=6) and hence the interval of x should be $0 \leq x < 6$.

$\therefore$ Length of the interval is $6-0=6$ (1)

Comparing with $2l = 6$.

$\therefore \boxed{l=3}$

$$y = f(x) = \frac{a_0}{2} + \sum_{n=1}^{\infty} a_n \cos \frac{n\pi x}{l} + \sum_{n=1}^{\infty} b_n \sin \frac{n\pi x}{l}$$

Since $l=3$, the series containing the first harmonic is (1)

$$y = f(x) = \frac{a_0}{2} + a_1 \cos \frac{\pi x}{3} + b_1 \sin \frac{\pi x}{3}$$

x	$\theta = \pi x/3$	y	$\cos\theta$	$y\cos\theta$	$\sin\theta$	$y\sin\theta$
0	0	9	1	9	0	0
1	60°	18	0.5	9	0.866	15.588
2	120°	24	−0.5	−12	0.866	20.784
3	180°	28	−1	−28	0	0
4	240°	26	−0.5	−13	−0.866	−22.516
5	300°	20	0.5	10	−0.866	−17.32
		125		−25		−3.464

(3)

$a_0 = \frac{2}{N}\sum y = \frac{1}{3}(125) \simeq 41.67$ (2)

$a_1 = \frac{2}{N}\sum y\cos\theta = \frac{1}{3}(-25) \simeq -8.33$

$b_1 = \frac{2}{N}\sum y\sin\theta = \frac{1}{3}(-3.464) \simeq -1.155$

7M

$$a_0 = \frac{2}{\pi}\left\{ \int_0^{\pi/2} x\,dx + \int_{\pi/2}^{\pi} (\pi - x)\,dx \right\}$$

$$= \frac{2}{\pi}\left\{ \left[\frac{x^2}{2}\right]_0^{\pi/2} + \left[\pi x - \frac{x^2}{2}\right]_{\pi/2}^{\pi} \right\}$$ (1)

$$a_0 = \frac{2}{\pi}\left\{ \left(\frac{\pi^2}{8} - 0\right) + \left(\pi^2 - \frac{\pi^2}{2}\right) - \left(\frac{\pi^2}{2} - \frac{\pi^2}{8}\right) \right\} = \pi/2$$

$$\frac{a_0}{2} = \pi/4$$

$$a_n = \frac{2}{\pi}\left\{ \int_0^{\pi/2} x \cos nx\,dx + \int_{\pi/2}^{\pi} (\pi - x)\cos nx\,dx \right\}$$

Applying Bernoullis rule to each of the integrals.

$$a_n = \frac{2}{\pi}\left\{ \left[x \cdot \frac{\sin nx}{n} - (1) \cdot -\frac{\cos nx}{n^2}\right]_0^{\pi/2} + \left[(\pi - x)\frac{\sin nx}{n} - (-1) \cdot -\frac{\cos nx}{n^2}\right]_{\pi/2}^{\pi} \right.$$ (2)

$$= \frac{2}{\pi}\left\{ \frac{\pi}{2n}\sin\frac{n\pi}{2} + \frac{1}{n^2}\left(\cos\frac{n\pi}{2} - 1 - \cos n\pi + \cos\frac{n\pi}{2}\right) - \frac{\pi}{2n}\sin\frac{n\pi}{2} \right\}$$

$$a_n = \frac{-2}{\pi n^2}\left(2 - 2\cos\frac{n\pi}{2}\right)$$ where $n = 2, 4, 6, \ldots$

$$a_n = -\frac{4}{\pi n^2}\left(1 - \cos\frac{n\pi}{2}\right), \quad n = 2, 4, 6, \ldots$$

(2)

$$\therefore a_n = \frac{-4}{\pi n^2}(2)$$

Thus the required cosine half range F.S is given by

$$f(x) = \frac{\pi}{4} - \frac{8}{\pi}\sum_{n=2,6,10,\ldots}^{\infty} \frac{1}{n^2}\cos nx$$

$$= \frac{\pi}{4} - \frac{8}{\pi}\left(\frac{1}{2^2}\cos 2x + \frac{1}{6^2}\cos 6x + \frac{1}{10^2}\cos 10x + \cdots\right)$$ 1

7M

$$f(x) = \frac{\pi}{4} - \frac{2}{\pi}\left(\frac{\cos 2x}{1^2} + \frac{\cos 6x}{3^2} + \frac{\cos 10x}{5^2} + \cdots\right)$$

MODULE - 04.

7a. F.T of $f(x)$ is given by

$$F(u) = \int_{x=-\infty}^{\infty} f(x)\, e^{iux} . dx$$

$$F(u) = \int_{x=-a}^{a} 1 . e^{iux} . dx$$

$$F(u) = \left[\frac{e^{iux}}{iu}\right]_{x=-a}^{a} = \frac{1}{iu}\{e^{iua} - e^{-iua}\}.$$ (2)

$$F(u) = \frac{1}{iu}\{(\cos au + i\sin au) - (\cos au - i\sin au)\}$$

$$F(u) = \frac{2\sin au}{u}.$$

Apply Inverse Fourier Transform.

$$\frac{1}{2\pi}\int_{-\infty}^{\infty} F(u)\, e^{-iux} . du = f(x)$$ (2)

ie $$f(x) = \frac{1}{2\pi}\int_{-\infty}^{\infty} \frac{2\sin au}{u} . e^{-iux} . du = \frac{1}{\pi}\int_{-\infty}^{\infty} \frac{\sin au}{u} . e^{-iux} . du$$

Put $x=0$

since $x=0$ is a point of continuity of $f(x)$

the value of $f(x)$ at $x=0$ being $f(0)=1$

because $f(x) = 1$ for $|x| \le a$.

$$\frac{1}{\pi}\int_{-\infty}^{\infty} \frac{\sin au}{u} . du = 1$$

$$\frac{2}{\pi}\int_{0}^{\infty} \frac{\sin au}{u} . du = 1$$, since $\frac{\sin au}{u}$ is an even function (2)

$$\therefore \int_{0}^{\infty} \frac{\sin au}{u} . du = \pi/2$$

Putting $a=1$, $$\int_{0}^{\infty} \frac{\sin u}{u}\, du = \pi/2$$ 6M

By changing u to x.

we have,

$$\int_{0}^{\infty} \frac{\sin x}{x}\, dx = \pi/2.$$

7b we have,

$$F_s(u) = \int_0^\infty f(x)\sin ux\,dx \quad \text{and let} \quad f(x) = \frac{\bar{e}^{ax}}{x}$$

$$F_s(u) = \int_0^\infty \frac{\bar{e}^{ax}}{x}\sin ux\,dx \text{ ------ } ①$$ (1)

We cannot evaluate this integral directly

$$\frac{d}{du}\left[F_s(u)\right] = \int_0^\infty \frac{\bar{e}^{ax}}{\cancel{x}} \frac{\partial}{\partial u}(\sin ux)\,dx$$ (2)

$$= \int_0^\infty \frac{\bar{e}^{ax}}{x}\, x\cos ux\,dx$$

$$\frac{d}{du}\left[F_s(u)\right] = \int_0^\infty \bar{e}^{ax}\cos ux\,dx$$ (2)

$$= \left[\frac{\bar{e}^{ax}}{a^2+u^2}\left(-a\cos ux + u\sin ux\right)\right]_{x=0}^{\infty}$$

$$= \frac{1}{a^2+u^2}(0+a) = \frac{a}{a^2+u^2}$$

Integrating wrt 'u'

$$F_s(u) = \tan^{-1}(u/a) + c$$ (2)

put $u=0$ ∴ $F_s(0) = \tan^{-1}(0) + c$

But, $F_s(0) = 0$ from ① and hence $c=0$ 7M

Thus,

$$F_s(u) = \tan^{-1}(u/a).$$

7c] Let,

$$u_n = \cos(n\pi/2 + \pi/4)$$

$$= \cos(n\pi/2)\cos(\pi/4) - \sin(n\pi/2)\sin(\pi/4)$$ (1)

$$Z_T(u_n) = \frac{1}{\sqrt{2}}\left[Z_T\cos(n\pi/2) - Z_T\sin(n\pi/2)\right] \longrightarrow ①$$

Consider,

$$e^{i(n\pi/2)} = \left(e^{i\pi/2}\right)^n = k^n$$ (1)

w.k.T

$$Z_T(k^n) = \frac{z}{z-k}.$$

$$Z_T\left(e^{in\pi/2}\right) = \frac{z}{z-e^{i\pi/2}} = \frac{z}{z-\cos(\pi/2)-i\sin(\pi/2)} = \frac{z}{z-i}$$ (2)

$$Z_T\left(e^{in\pi/2}\right) = \frac{z(z+i)}{(z-i)(z+i)} = \frac{z^2+iz}{z^2+1}$$

$$Z_T\left[\cos(n\pi/2)+i\sin(n\pi/2)\right] = \frac{z^2}{z^2+1} + i\frac{z}{z^2+1}$$ (2)

$Z_T\left[\cos(n\pi/2)\right] = \frac{z^2}{z^2+1}$ and $Z_T\left[\sin(n\pi/2)\right] = \frac{z}{z^2+1}$ 1

Substituting eq ①

$$Z_T(u_n) = \frac{1}{\sqrt{2}}\left[\frac{z^2}{z^2+1} - \frac{z}{z^2+1}\right] = \frac{z(z-1)}{\sqrt{2}(z^2+1)}$$ 7M

8a Fourier transform of f(x) is given by

$$F(u) = \int_{-\infty}^{\infty} f(x)\, e^{iux}.\, dx$$ (2)

Here,

$$f(x) = e^{-|x|} = \begin{cases} e^{-x} & \text{for } x \geq 0 \\ e^{x} & \text{for } x < 0 \end{cases}$$

$$\therefore F(u) = \int_{-\infty}^{0} e^{x}.\, e^{iux}\, dx + \int_{0}^{\infty} e^{-x}.\, e^{iux}\, dx$$ (2)

$$F(u) = \int_{-\infty}^{0} e^{(1+iu)x}\, du + \int_{0}^{\infty} e^{-(1-iu)x}\, dx$$

$$= \left[\frac{e^{(1+iu)x}}{1+iu}\right]_{x=-\infty}^{0} + \left[\frac{e^{-(1-iu)x}}{-(1-iu)}\right]_{x=0}^{\infty}$$ (2)

$$= \left[\frac{1}{1+iu} - 0\right] + \left[0 - \frac{1}{-(1-iu)}\right]$$

$$= \frac{1}{1+iu} + \frac{1}{1-iu} = \frac{2}{1-i^2u^2} = \frac{2}{1+u^2}$$ 6M

Thus,

$$F(u) = \frac{2}{1+u^2}$$

8b. $X(z) = \frac{z^2}{(z-1)(z+3)}$

$\frac{X(z)}{z} = \frac{z}{(z-1)(z+3)} = \frac{A}{(z-1)} + \frac{B}{(z+3)}$ (1)

multiply both sids by $(z-1)(z+3)$
we get,

$z = A(z+3) + B(z-1)$ (2)

put,
$z = 1$; $1 = A(1+3) + B(0) \Rightarrow \boxed{A = 1/4}$

put,
$z = -3$; $-3 = A(0) + B(-3-1) \Rightarrow \boxed{B = 3/4}$

So,

$\frac{X(z)}{z} = \frac{(\frac{1}{4})}{(z-1)} + \frac{3/4}{(z+3)}$ (2)

multiply both sides by z $X(z) = (\frac{1}{4}) \cdot \frac{z}{(z-1)} + \frac{3}{4} \cdot \frac{z}{(z+3)}$

Apply inverse z-Transform.

$Z^{-1}\left[(\frac{1}{4}) \cdot \frac{z}{z-1}\right] = (\frac{1}{4}) \cdot 1^n$

$\therefore Z^{-1}\left[(3/4) \cdot \frac{z}{z+3}\right] = (3/4)(-3)^n$ (2)

Thus,

$x(n) = (1/4)\, u^n + 3/4\,(-3)^n u^n$ 7M

$x(n) = (1/4) + (\frac{3}{4})(-3)^n$ for $n \geq 0$

8c $y_{n+2} - 4y_n = 0$

Taking Z-Transform on both sides of the give eq (1)

$Z_T(y_{n+2}) - 4 Z_T(y_n) = Z_T(0)$

$z^2[\bar{y}(z) - y_0 - y_1 z^{-1}] - 4\bar{y}(z) = 0$

$[z^2 - 4]\,\bar{y}(z) - 2z = 0$ by using the given values

$\bar{y}(z) = \frac{2z}{z^2 - 6}$ (2)

$\frac{\bar{y}(z)}{z} = \frac{2}{(z-2)(z+2)} = \frac{A}{(z-2)} + \frac{B}{(z+2)}$

$2 = A(z+2) + B(z-2)$

$z = 2$: $2 = A(4)$ $\therefore A = 1/2$

$z = -2$: $2 = B(-4)$ $\therefore B = -1/2$ (1)

Hence,

$\bar{u}(z) = \frac{1}{2} \cdot \frac{z}{(z-2)} - \frac{1}{2} \cdot \frac{z}{(z+2)}$ (2)

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

$$u_n = \frac{1}{2}\{2^n - (-2)^n\} = \frac{2^n}{2} + \frac{(-2)^n}{-2}$$ 1

Thus, 7M

$u_n = 2^{n-1} + (-2)^{n-1}$ is the required solⁿ.

MODULE-05

9a.

x	0	1	2	3	4	5	6
$P(x)$	1k	3k	5k	7k	9k	11k	13k

The probability distribution is valid if $P(x) \geq 0$ and $\Sigma P(x) = 1$. (1)

Hence we must have $k \geq 0$ and $k+3k+5k+7k+9k+11k+13k=1$ (2)

ie $49k = 1$ or $\boxed{k = 1/49}$

Also,

$P(x \geq 5) = P(5) + P(6) = 11k + 13k = 24k = 24/49$ (2)

$P(3 < x \leq 6) = P(4) + P(5) + P(6) = 33k = 33/49$ 1

6M

9b) Given $\mu - 2.5$ and $\sigma = \sqrt{1.875} = 1.36$.

S.n.v, $z = \frac{\bar{x} - \mu}{\sigma} = \frac{x - 2.5}{1.36}$ (1)

i) 8 or more questions

$x = 8$, $z = \frac{8-2.5}{1.36} = 4.04$ (2)

$P(x \geq 8) = P(z \geq 4.04) = 0.5 - \phi(4.04) = 0.5 - 0.5 = 0$

$\therefore$ No of students $= 4096 \times 0 = 0$

ii] 2 or less

$P(x = 2) \Rightarrow z = \frac{8-2}{1.36} = 4.41$ (2)

$P(x \leq 2) = P(z \leq 4.41)$

$= 0.5 + \phi(4.41)$

$= 0.5 + 0.5 = 1$

No of students $= 4096 \times 1 = 4096$

iii) 5 questions.

If $x=5 \Rightarrow z = \frac{8-5}{1.36} = 2.2$

$P(x=2) \Rightarrow P(z=2.2) = \phi(2.2) = 0.4861$ (2)

$\therefore$ No of students $= 4096 \times 0.4861 = 1991$.

7M

9c. Let μ and σ be the mean & S.D of the normal dist.

$P(x < 45) = 0.31$ & $P(x > 64) = 0.08$ (1)

we have,

S.n.v = $z = \frac{x-\mu}{\sigma}$

when,

$x = 45$, $z = \frac{45-\mu}{\sigma} = z_1$ (2)

$x = 64$, $z = \frac{64-\mu}{\sigma} = z_2$

we have,

$P(z < z_1) = 0.31$ & $P[z > z_2) = 0.08$

$0.5 + \phi(z_1) = 0.31$ & $0.5 - \phi(z_2) = 0.08$ (2)

$\phi(z_1) = 0.19$ & $\phi(z_2) = 0.42$

Refering to the normal probability table.

$0.1915\ (\approx 0.19) = \phi(0.5)$ & $0.4192\ (\approx 0.42) = \phi(1.4)$

$\phi(z_1) = -\phi(0.5)$ and $\phi(z_2) = \phi(1.4)$ (2)

$z_1 = -0.5$ and $z_2 = 1.4$

$\frac{45-\mu}{\sigma} = -0.5$ & $\frac{64-\mu}{\sigma} = 1.4$

$\mu - 0.5\sigma = 45$ and $\mu + 1.4 = 64$ 7M

$\mu = 50$, $\sigma = 10$

Thus mean $= 50$ and S.D $= 10$.

10a) i) Type I and Type II Error:

If a hypothesis is rejected while it should have been accepted is known as Type I Error. (2)

If a hypothesis is accepted while it should have been rejected is known as Type II Error. (2)

ii) Alternative Hypothesis:

This hypothesis is opposite to the Null hypothesis or we simply called it as null hypothesis (2)

iii) significance level:

The probability level below which we reject the hypothesis is known as the level of significance. 6M

10b) $\bar{x} = \frac{\Sigma x}{n} = \frac{31}{12} = 2.5833$

$s^2 = \frac{1}{n-1}\Sigma(x-\bar{x})^2 = \frac{1}{n-1}\left\{\Sigma x^2 - \frac{1}{n}(\Sigma x^2)\right\}$ (2)

$s^2 = \frac{1}{11}\left\{185 - \frac{1}{12}(31)^2\right\} = 9.538$

$\boxed{s = 3.088}$ (1)

we have,

$t = \frac{\bar{x}-\mu}{s}\sqrt{n}$.

Let us suppose that the stimulus administration is not accompanied with increase in blood pressure $\boxed{\mu=0}$ (1)

$t = \frac{2.5833-0}{3.088}\sqrt{12} = 2.8979 \simeq 2.9 > 2.201$ (2)

Hence the hypothesis is rejected at 5% level of significance. We conclude with 95% confidence that the stimulus in general is accompanied with increase in blood pressure. 6M

0c]

No of Heads	0	1	2	3	4
Frequency	5	29	36	25	5

Let x denotes the number of heads and f the Corresponding frequency. since the data is in the form of a frequency dist. we shall first calculate the mean (2

$$mean(\mu) = \frac{\Sigma fx}{\Sigma f} = \frac{0+29+72+75+20}{100} = \frac{196}{100} = 1.96$$

But,
$\mu = np$ for the Binomial Dist.

Hence, $n = 4$ (2)

Hence $4p = 1.96$ or $\boxed{p = 0.49}$ $\therefore q = 1-p = 0.51$

Binomial Dist Probability function is given by

$p(x) = nC_x\, p^x q^{n-x} = 4C_x\,(0.49)^x\,(0.51)^{4-x}$ (1)

since 4 coins were tossed 100 times expected frequency are ~~tt~~ obtained from.

$F(x) = 100\, p(x) = 100\; 4C_x\,(0.49)^x\,(0.51)^{4-x}$

where
$x = 0, 1, 2, 3, 4$

$F(0) = 100(0.51)^4 = 6.765 \approx 7$

$F(1) = 100 . 4C_1(0.49)(0.51)^3 = 400(0.49)(0.51)^3 = 25.99 \approx 26$ (2)

$F(2) = 100\; 4C_2(0.49)^2(0.51)^2 = 600(0.49)^2(0.51)^2 = 37.47 \approx 37$

$F(3) = 100 . 4C_3(0.49)^3(0.51)^3 = 400(0.49)^3(0.51) = 24 \approx 24$

$F(4) = 100\; 4C_4(0.49)^4 = 100(0.49)^4 = 5.76 \approx 6$

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