DIRECTORATE OF GOVERNEMENT EXAMINATION, CHENNAI-6

HIGHER SECONDARY EXAMINATIONS (FIRST YEAR) MAY 2022

BUSINESS MATHEMATICS AND STATISTICS - ANSWER KEY

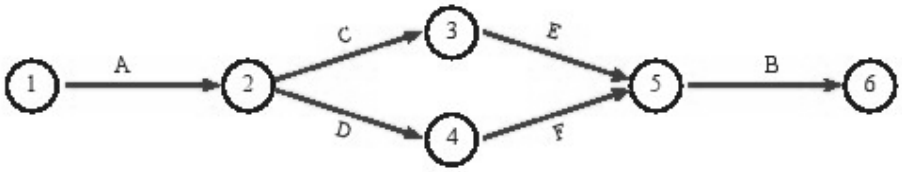
General Instructions

1. Answers written only in **BLACK** or **BLUE** should be evaluated.
2. For objective type questions, award 1 mark for "writing the correct option's code and the corresponding option's answer".
3. Award "0 marks" for one who wrote both "option's code" and "option's answer" with one of them is not correct.
4. Marks should be awarded for suitable alternative method also.
5. Mark(s) should not be reduced for the correct answer / stage, if it is written without formula / properties also, 2* means award one mark for the formula. or award one mark for the correct previous stage.
6. Award full mark directly, if the solution is arrived with no mistakes without giving weightage for the stages.
7. The stage mark is essential, only if the part of the solution is incorrect.
8. Award marks, if the answer is in decimal value and also approximately equal to the key answer
9. **Important Note for Part II, Part III and Part IV**

   For a particular stage in which the stage mark is greater than 1 and one who begins with correct step but reaches with incorrect solution, for such suitable credits should be given by breaking the stage marks.

PART – I			$20 \times 1 = 20$
Qu.No	**Option**	**Answer**	**Mark**
1	(d)	0, 1	1
2	(d)	18	1
3	(a)	5	1
4	(d)	n^r	1
5	(a)	$\frac{1}{3}$	1
6	(b)	3	1
7	(d)	$22^\circ 30'$	1
8	(b)	$\frac{5\pi}{24}$	1
9	(b)	*2*	1
10	(b)	$f(x)=x^3+5$	1
11	(a)	$-x^2$	1
12	(b)	$\lvert\eta_d\rvert>1$	1
13	(b)	$\eta_d=\frac{AR}{AR-MR}$	1
14	(a)	₹91	1
15	(b)	11.25	1
16	(b)	$\frac{1}{36}$	1
17	(c)	Independent	1
18	(b)	Negative	1
19	(b)	Income and expenditure	1
20	(b)	$E_j - E_i = L_j - L_i = t_{ij}$	1

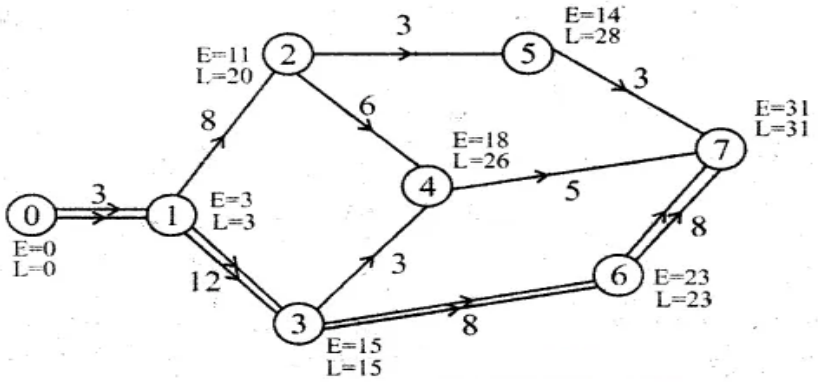
PART - II		
Answer any 7 questions. Question no. 30 is compulsory.		$7 \times 2 = 14$
Qu.No.	**Answer**	**Stage Marks**
21	$\lvert A\rvert = 16 \neq 0$	
	A^{-1} exists	1
	adj A = $\begin{bmatrix} 2 & -4 \\ 3 & 2 \end{bmatrix}$	
	$A^{-1} = \frac{1}{16}\begin{bmatrix} 2 & -4 \\ 3 & 2 \end{bmatrix}$	1

22	n = 10, r = 4 Number of words = $10P_4 = 5040$	1 1
23	$P(x_1, y_1)$ locus point, O is the origin Given OP = 3AP $OP^2=9AP^2$ $8x^2-y^2=0$	 1 1
24	$\tan 75^0 = \tan(45^0 + 30^0)$ $= \frac{\tan 45^0+\tan\ 30^0}{1-\tan\ 45^0 \tan\ 30^0}$ $\tan\ 75^0 = \frac{\sqrt{3}+1}{\sqrt{3}-1}$ $\cot\ 75^0 = \frac{\sqrt{3}-1}{\sqrt{3}+1}$	 1 1
25	Marginal value = 27 , i.e., $\frac{dy}{dx}=27$ $\frac{dy}{dx} = 3x^2$ $x = \pm 3$	 1 1
26	Number of share = 62 Market value of a share = 132 Market value of 62 shares = 62 x 132 = ₹ 8184	1 1
27	$P(A \cap B) = P(A) \cdot P(B)$ $= \frac{3}{5} \times \frac{1}{5} = \frac{3}{25}$	1 1
28	$r = \frac{N\sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x)^2}\sqrt{N\sum y^2 - (\sum y)^2}}$ $= \frac{10(-115) - 50(-30)}{\sqrt{10(290) - (50)^2}\sqrt{10(300) - (-30)^2}}$ = 0.382	 1 1
29		2*
30	$\frac{dx}{dt} = \frac{-1}{t^2}, \frac{dy}{dt} = -\text{Sin t}$ $\frac{dy}{dx} = t^2 \text{Sin t}$	1 1

PART - III		
Answer any 7 questions. Question no. 40 is compulsory.		$7 \times 3 = 21$
Qu. No.	**Answer**	**Stage Marks**
31	$AB=\frac{1}{35}\begin{bmatrix}35 & 0 & 0\\ 0 & 35 & 0\\ 0 & 0 & 35\end{bmatrix}=I$ $BA=\frac{1}{35}\begin{bmatrix}35 & 0 & 0\\ 0 & 35 & 0\\ 0 & 0 & 35\end{bmatrix}=I$ $AB = BA = I$ A and B are inverse of each other **(Note: Any other alternate correct method can be awarded marks)**	1 1 1
32	Number of ways of selecting 3 consonants out of 7 and 2 vowels out of 4 $= {}^7C_3 \times {}^4C_2 = 210$ Number of ways of arranging all the 5 letters of the word among themselves $= 5! = 120$ Required number of ways forming the word = 120 X 210 = 25200 ways	1 1 1
33	$\frac{\text{Sin A - Sin C}}{\text{Cos C-Cos A}}=\frac{2\text{Sin}\left(\frac{A-C}{2}\right)\cdot\text{Cos}\left(\frac{A+C}{2}\right)}{2\text{Sin}\left(\frac{A+C}{2}\right)\cdot\text{Sin}\left(\frac{A-C}{2}\right)}$ → → $=\frac{\text{Cos}\left(\frac{A+C}{2}\right)}{\text{Sin}\left(\frac{A+C}{2}\right)}=\text{Cot}\left(\frac{A+C}{2}\right)=\text{Cot B}$	1(Nr) 1(Dr) 1
34	$\frac{dy}{dx}=\frac{(1+3x)\frac{d}{dx}(1-3x)-(1-3x)\frac{d}{dx}(1+3x)}{(1+3x)^2}$ $=\frac{-6}{(1+3x)^2}$	2* 1
35	$3x^2+20x-48=2x$ (OR) $dy/dx=2x$ $x^2+6x-16=0$ $x=-8, x=2$	1 1 1
36	Face value = ₹ 100 Market value = ₹ (100-17+1) = ₹84 Percentage of his income $=\frac{12\times100}{84}$ ∴Percentage of his income=$14\frac{2}{7}\%$ (OR) 14. 28%	1 1 1
37	Mean = $\frac{\Sigma x}{n}$=4400 Mean deviation about mean = $\frac{\Sigma\lvert D\rvert}{n}=240$ Co-eff. of MD = $\frac{\text{MD}}{\text{mean}}$=0·055	1 1 1

38	$\sum d^2 = 226$ $\rho = 1-\frac{6\sum d^2}{N(N^2-1)}$ $= 1-\frac{6(226)}{10(99)}$ $=-0.3696=-0.37$	1 1 1
39	$I-B=\begin{bmatrix}0.4 & -0.9\\ -0.2 & 0.2\end{bmatrix}$ main diagonal elements of (I - B) are positive $\|I - B\| = - 0.1<0$ $\therefore$ The system is not viable	1 1 1
40	Equation of a circle is $x^2 + y^2 + \frac{2}{3}x - \frac{4}{3}y - \frac{8}{3} = 0$ Centre$= \left(\frac{-1}{3}, \frac{2}{3}\right)$ Radius $= \sqrt{g^2+f^2-c} = \sqrt{\frac{1}{9}+\frac{4}{9}+\frac{8}{3}} = \frac{\sqrt{29}}{3}$ Units	1 1 1

PART - IV		
Answer all the questions.		$7 \times 5 = 35$
Qu.No.	**Answer**	**Stage Marks**
41 (a)	$(AB)^{-1}=\begin{bmatrix}-1 & 3\\ 1 & -2\end{bmatrix}$ $B^{-1}=\frac{1}{\|B\|}\text{adj } B=\begin{bmatrix}2 & 1\\ -1 & 0\end{bmatrix}$ $A^{-1}=\frac{1}{\|A\|}\text{adj } A=\begin{bmatrix}-1 & 2\\ 1 & -1\end{bmatrix}$ $B^{-1}A^{-1}=\begin{bmatrix}-1 & 3\\ 1 & -2\end{bmatrix}$ $(AB)^{-1}=B^{-1}A^{-1}$	1 1 1 1 1
41(b)	**Numerator:** Sin $(180^0 + A) = -$ Sin A Cos $(90^0 - A)$ = Sin A tan $(270^0 - A)$ = cot A **Denominator:** Sec $(540^0 - A) = -$Sec A cos $(360^0 + A)$ = Cos A Cosec $(270^0 + A) = -$Sec A L.H.S$= \frac{-\text{Sin A SinA .Cot A}}{-\text{Sec A cos A}(-\text{Sec A})} = -\text{SinA Cos}^2\text{A}$	2* 2* 1

42(a)	(i) 3 bowlers, 1 wicket keepers and 7 others = $4C_3 \times 2C_1 \times 10C_7 = 960$ ways (ii) 3 bowlers, 2 wicket keepers and 6 others = $4C_3 \times 2C_2 \times 10C_6 = 840$ ways (iii) 4 bowlers, 1 wicket keepers and 6 others = $4C_4 \times 2C_1 \times 10C_6 = 420$ ways (iv) 4 bowlers, 2 wicket keepers and 5 others = $4C_4 \times 2C_2 \times 10C_5 = 252$ ways Total number of ways = 2472 ways	1 1 1 1 1
42(b)	$P(E_1)=\frac{4}{5}, \quad P(E_2)=\frac{1}{5}$ $P\left(\frac{E}{E_1}\right)=\frac{1}{6}, \quad P\left(\frac{E}{E_2}\right)=\frac{5}{6}$ $P\left(\frac{E_1}{E}\right)=\frac{P\left(\frac{E}{E_1}\right) . P(E_1)}{P(E_1)P\left(\frac{E}{E_1}\right)+P(E_2)P\left(\frac{E}{E_2}\right)}$ $=\frac{\frac{4}{5}\times\frac{1}{6}}{\left(\frac{4}{5}\times\frac{1}{6}\right)+\left(\frac{1}{5}\times\frac{5}{6}\right)}$ $=\frac{4}{9}$	1 1 1 1 1
43(a)	A(2, 1), B(1, 2) P(x, y) PA : PB = 2:1 PA = 2PB $\sqrt{(x-2)^2+(y-1)^2}=2\sqrt{(x-1)^2+(y-2)^2}$ Locus of P is $3x^2 + 3y^2 - 4x - 14y + 15 = 0$	1 1 1 2*
43(b)	 	2

Activity	Duration	EST	EFT = EST + t_{ij}	LSt = LFT + t_{ij}	LFT
0-1	3	0	3	3	3
1-2	8	3	11	12	20
1-3	12	3	15	3	15
2-4	6	11	17	20	26
2-5	3	11	14	25	28
3-4	3	15	18	23	26
3-6	8	15	23	15	23
4-7	5	18	23	26	31
5-7	3	14	17	28	31
6-7	8	23	31	23	31

Critical path 0-1-3-6-7 and the duration is 31 weeks.

2

1

44(a)	$y_1 = -m\,a\sin mx + mb\cos mx$ $y_2 = -m^2 a\cos mx - m^2 b\sin mx$ $y_2 + m^2 y = 0$	2 2 1
44(b)	$P(n) = n^2+n$, is an even number When, n=1, P(1) is true when n=k, $P(k) = k^2+k$, is an even number P(k) is true $P(k+1) = (k+1)^2+(k+1)$, is an even number P(k+1) is true P(n) is true for $n\in N$	 1 1 1 1 1
45(a)	$f'(x) = 6x^2+18x+12$ $f'(x) = 0 \Rightarrow x = -2$ or $x = -1$ $f(-2) = -3$ $f(-1) = -4$ Stationary points are (-2, -3), (-1, -4)	1 1 1 1 1
45(b)	<table><tr><th>No. of units produced (x)</th><th>Cost of production (y)</th></tr><tr><td>500 (x_1)</td><td>6000 (y_1)</td></tr><tr><td>1000 (x_2)</td><td>9000(y_2)</td></tr></table> $\frac{y-y_1}{y_2-y_1} = \frac{x-x_1}{x_2-x_1}$ $\frac{y-6000}{9000-6000} = \frac{x-500}{1000-500}$ $6x - y + 3000 = 0$ (or) $y = 6x + 3000$	1 2* 2*
46(a)	$C = 2x\left(\frac{x+5}{x+2}\right) + 7$ $= \frac{2x^2+10x}{x+2} + 7$ $MC = \frac{2x^2+8x+20}{(x+2)^2}$ $= 2\left(1 + \frac{6}{(x+2)^2}\right)$ $\therefore$ when x increases, MC decreases.	1 2* 1 1
46(b)	(i) No. of shares bought = $\frac{\text{Investment}}{\text{M.V of one share}}$ = 1200 shares (ii) Total dividend = No. of share x Rate of dividend x face value of a share = ₹ 21,600 (iii) Percentage of return = $\frac{21,600}{96,000} \times 100 = \frac{45}{2}\%$ (or) 22.5 %	2* 2* 1
47(a)	$Q_1 = L + \left(\frac{\frac{N}{4} - pcf}{f}\right) \times c$ $= 20 + \left(\frac{16.75-12}{19}\right) \times 10$ = 22.5	 2*

	$Q_3 = L + \left(\frac{\frac{3N}{4} - pcf}{f}\right) x\ c$	
	$= 50 + \left(\frac{50.25 - 46}{9}\right) x10$	2*
	= 55.72	1
	Q.D = 1/2 (Q_3-Q_1) = 16.11	
47(b)	$\sum dx=10,\ \sum dx^2=62,\ \sum dy=4,\ \sum dy^2=42$ and $\sum dxdy=26$	2*
	$r = \frac{N\sum dx\ dy - (\sum dx)(\sum dy)}{\sqrt{N\sum dx^2 - (\sum dx)^2}\sqrt{N\sum dy^2 - (\sum dy)^2}}$	1
	$= \frac{(8)(26) - (10)(24)}{\sqrt{(8)(62) - (10)^2}\sqrt{(8)(42) - (4)^2}}$	1
	r = +0.472 (or) Heights of father and their respective sons are positively correlated	1
	(ALITER)	
	$\sum X= 546, \sum Y = 548, \sum x^2 = 37314,$ $\sum Y^2= 37578, \sum xy = 37422$	2*
	$r = \frac{8(37422) - (546x548)}{\sqrt{8(37314) - (546)^2}x\sqrt{8(37578) - (548)^2}}$	2*
	=168 / 355.98	
	r = 0.472	
	Heights of father and their respective sons are positively correlated	1