SUMMER– 2019 EXAMINATION

Subject Name: Applied Mathematics **Model Answer** **Subject Code: 22206**

Important Instructions to Examiners:

1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.
4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.		**Attempt any FIVE of the following:**	**10**
	a)	State whether the function is even or odd, If $f(x)=3x^4-2x^2+\cos x$	**02**
	Ans	$f(x)=3x^4-2x^2+\cos x$	½
		$\therefore f(-x)=3(-x)^4-2(-x)^2+\cos(-x)$	½
		$\therefore f(-x)=3x^4-2x^2+\cos x$	½
		$\therefore f(-x)=f(x)$	
		$\therefore$ function is an even function	½
		--	
	b)	If $f(x)=x^2+6x+10$ find $f(2)+f(-2)$	**02**
	Ans	$f(2)=(2)^2+6(2)+10=26$	½
		$f(-2)=(-2)^2+6(-2)+10=2$	½
		$\therefore f(2)+f(-2)=26+2$	
		$=28$	1
		--	
	c)	Find $\frac{dy}{dx}$ if $y=\log x+\log_5 x+\log_5 5$	**02**
	Ans	$y=\log x+\log_5 x+\log_5 5$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	c)	$\therefore\ y=\log x+\frac{\log x}{\log 5}+\log_5 5$ $\therefore \frac{dy}{dx}=\frac{1}{x}+\frac{1}{x\log 5}+0$ $\therefore \frac{dy}{dx}=\frac{1}{x}+\frac{1}{x\log 5}$	2
	d)	Evaluate $\int \sin^2 x\ dx$	**02**
	Ans	$\int \sin^2 x\ dx$ $=\frac{1}{2}\int 2\sin^2 x\ dx$ $=\frac{1}{2}\int (1-\cos 2x)\ dx$ $=\frac{1}{2}\left(x-\frac{\sin 2x}{2}\right)+c$	1 1
	e)	Evaluate $\int \left(x^a+a^x+a^a\right)\ dx$	**02**
	Ans	$\int \left(x^a+a^x+a^a\right)\ dx$ $=\frac{x^{a+1}}{a+1}+\frac{a^x}{\log a}+a^a x+c$	2
	f)	Find the area under the curve $y=e^x$ bet^n the ordinates $x=0$ and $x=1$	**02**
	Ans	Area $A=\int_a^b y\ dx$ $=\int_0^1 e^x dx$ $=\left[e^x\right]_0^1$ $=e^1-e^0$ $=e-1$	½ ½ ½ ½

Q. No.	Sub Q.N.	Answers	Marking Scheme
1.	g)	An unbaised coin is tossed 5 times. Find the probability of getting three heads.	
	Ans	$n=5\ ,\ p=\frac{1}{2}\ ,\ q=\frac{1}{2}\ ,\ r=3$	
		$\therefore P(r)={}^{n}C_{r}\,p^{r}q^{n-r}$	
		$\therefore P(3)={}^{5}C_{3}\left(\frac{1}{2}\right)^{3}\left(\frac{1}{2}\right)^{5-3}$	1
		$\therefore P(3)=\frac{5}{16}$ or 0.3125	1
		--	
2.		**Attempt any THREE of the following:**	**12**
	a)	If $x^2+y^2=4xy$ find $\frac{dy}{dx}$ at $(2,-1)$	**04**
	Ans	$x^2+y^2=4xy$	
		$\therefore 2x+2y\frac{dy}{dx}=4\left(x\frac{dy}{dx}+y.1\right)$	2
		$\therefore 2x+2y\frac{dy}{dx}=4x\frac{dy}{dx}+4y$	
		$\therefore (2y-4x)\frac{dy}{dx}=4y-2x$	
		$\therefore \frac{dy}{dx}=\frac{4y-2x}{2y-4x}$	1
		$\therefore \frac{dy}{dx}=\frac{2y-x}{y-2x}$	
		at $(2,-1)$	
		$\therefore \frac{dy}{dx}=\frac{2(-1)-2}{-1-2(2)}$	
		$\therefore \frac{dy}{dx}=\frac{4}{5}$	1
		--	
	b)	If $x=a(1+\cos\theta)\ ,\ y=a(1-\cos\theta)$ find $\frac{dy}{dx}$	**04**
	Ans	$x=a(1+\cos\theta)\quad ,\quad y=a(1-\cos\theta)$	

Q. No.	Sub Q. N.	Answers	Marking Scheme
2.	b)	$\therefore \frac{dx}{d\theta} = -a\sin\theta$, $\frac{dy}{d\theta} = a\sin\theta$	1+1
	Ans	$\frac{dy}{dx} = \frac{\frac{dy}{d\theta}}{\frac{dx}{d\theta}} = \frac{a\sin\theta}{-a\sin\theta}$	1
		$\therefore \frac{dy}{dx} = -1$	1
	c)	A metal wire of 40 cm long is bent to form a rectangle.Find its dimensions when its area is maximum.	**04**
	Ans	$2x + 2y = 40$ $\therefore x + y = 20$ $\therefore y = 20 - x$ Area $A = xy$	
		$\therefore A = x(20 - x)$ $\therefore A = 20x - x^2$	1
		$\therefore \frac{dA}{dx} = 20 - 2x$	1
		$\therefore \frac{d^2A}{dx^2} = -2$	½
		Consider $\frac{dA}{dx} = 0$ $20 - 2x = 0$ $\therefore x = 10$ at $x = 10$ $\therefore \frac{d^2A}{dx^2} = -2 < 0$	1
		$\therefore$ Area is maximum at $x = 10$ $\therefore x = 10, y = 10$	½
	d)	A telegraph wire hangs in the form of a curve $y = a.\log\sec\left(\frac{x}{a}\right)$ where 'a' is constant. Show that the curvature at any point is $\frac{1}{a}.\cos\left(\frac{x}{a}\right)$.	**04**

Q. No.	Sub Q.N.	Answers	Marking Scheme
2.	d)	$y = a.\log\sec\left(\frac{x}{a}\right)$	
		$\therefore \frac{dy}{dx} = a\frac{1}{\sec\left(\frac{x}{a}\right)}\sec\left(\frac{x}{a}\right)\tan\left(\frac{x}{a}\right)\frac{1}{a}$	1
		$\therefore \frac{dy}{dx} = \tan\left(\frac{x}{a}\right)$	
		$\therefore \frac{d^2y}{dx^2} = \sec^2\left(\frac{x}{a}\right)\frac{1}{a}$	1
		$\therefore$ Radius of curvature $\rho = \frac{\left[1+\left(\frac{dy}{dx}\right)^2\right]^{3/2}}{\frac{d^2y}{dx^2}}$	
		$= \frac{\left[1+\tan^2\left(\frac{x}{a}\right)\right]^{3/2}}{\sec^2\left(\frac{x}{a}\right)\frac{1}{a}}$	½
		$= \frac{a\left[\sec^2\left(\frac{x}{a}\right)\right]^{3/2}}{\sec^2\left(\frac{x}{a}\right)}$	
		$= \frac{a\sec^3\left(\frac{x}{a}\right)}{\sec^2\left(\frac{x}{a}\right)}$	
		$\therefore$ Radius of curvature $\rho = a\sec\left(\frac{x}{a}\right)$	1
		$\therefore$ curvature $= \frac{1}{\rho} = \frac{1}{a}\cos\left(\frac{x}{a}\right)$	½
		--	
3.		**Attempt any <u>THREE</u> of the following:**	**12**
	a)	Find the equation of tangent and normal to the curve $y = x(2-x)$ at point $(2,0)$	**04**

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	a) Ans	$y = x(2-x)$ $\therefore y = 2x - x^2$ $\therefore \frac{dy}{dx} = 2 - 2x$ at $(2,0)$ $\therefore \frac{dy}{dx} = 2 - 2(2)$ $\therefore \frac{dy}{dx} = -2$ $\therefore$ slope of tangent , $m = -2$ Equation of tangent at $(2,0)$ is $y - 0 = -2(x-2)$ $\therefore y = -2x + 4$ $\therefore 2x + y - 4 = 0$ $\therefore$ slope of normal , $m' = \frac{-1}{m} = \frac{1}{2}$ Equation of normal at $(2,0)$ is $y - 0 = \frac{1}{2}(x-2)$ $\therefore 2y = x - 2$ $\therefore x - 2y - 2 = 0$	½ ½ ½ ½ ½ ½ ½ ½
		--	**04**
	b) Ans	Find $\frac{dy}{dx}$ if $y = a^x + x^a + a^a + x^x$ $y = a^x + x^a + a^a + x^x$ Let $u = x^x$ Taking log on both sides, $\therefore \log u = \log x^x$ $\therefore \log u = x \log x$ $\therefore \frac{1}{u}\frac{du}{dx} = x\frac{1}{x} + \log x.1$ $\therefore \frac{1}{u}\frac{du}{dx} = 1 + \log x$	1

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	b)	$\therefore \frac{du}{dx} = u\left(1+\log x\right)$	
		$\therefore \frac{du}{dx} = x^x\left(1+\log x\right)$	1
		$y = a^x + x^a + a^a + x^x$	
		$\therefore \frac{dy}{dx} = a^x \log a + ax^{a-1} + 0 + x^x\left(1+\log x\right)$	2
		$\therefore \frac{dy}{dx} = a^x \log a + ax^{a-1} + x^x\left(1+\log x\right)$	
		--	
	c)	If $y = \tan^{-1}\left(\frac{5x}{1-6x^2}\right)$ find $\frac{dy}{dx}$	**04**
	Ans	$y = \tan^{-1}\left(\frac{5x}{1-6x^2}\right)$	
		$\therefore y = \tan^{-1}\left(\frac{3x+2x}{1-(3x)(2x)}\right)$	1
		$\therefore y = \tan^{-1}(3x) + \tan^{-1}(2x)$	1
		$\therefore \frac{dy}{dx} = \frac{1}{1+(3x)^2}(3) + \frac{1}{1+(2x)^2}(2)$	2
		$\therefore \frac{dy}{dx} = \frac{3}{1+9x^2} + \frac{2}{1+4x^2}$	
		--	
	d)	Evaluate $\int \frac{(x-1)e^x}{x^2.\sin^2\left(\frac{e^x}{x}\right)}\, dx$	**04**
	Ans	$\int \frac{(x-1)e^x}{x^2.\sin^2\left(\frac{e^x}{x}\right)}\, dx$	
		Put $\frac{e^x}{x} = t$	
		$\therefore \frac{xe^x - e^x 1}{x^2}\, dx = dt$	1

Q. No.	Sub Q.N.	Answers	Marking Scheme
3.	d)	$\therefore \frac{e^x(x-1)}{x^2}\,dx = dt$	
		$\int \frac{1}{\sin^2 t}\,dt$	
		$= \int \operatorname{cosec}^2 t\,dt$	1
		$= -\cot t + c$	1
		$= -\cot\left(\frac{e^x}{x}\right) + c$	1
4.		**Attempt any <u>THREE</u> of the following:**	**12**
	a)	Evaluate $\int \frac{1}{x+\sqrt{x}}\,dx$	**04**
	Ans	$\int \frac{1}{x+\sqrt{x}}\,dx$	
		$= \int \frac{1}{\sqrt{x}\left(\sqrt{x}+1\right)}\,dx$	
		Put $\sqrt{x}+1 = t$	
		$\therefore \frac{1}{2\sqrt{x}}\,dx = dt$	1
		$\therefore \frac{1}{\sqrt{x}}\,dx = 2dt$	
		$= 2\int \frac{1}{t}\,dt$	1
		$= 2\log t + c$	1
		$= 2\log\left(\sqrt{x}+1\right) + c$	1
	b)	Evaluate $\int \frac{dx}{5+4\cos x}$	**04**
	Ans	$\int \frac{dx}{5+4\cos x}$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	b)	Put $\tan\frac{x}{2}=t$, $dx=\frac{2dt}{1+t^2}$, $\cos x=\frac{1-t^2}{1+t^2}$	1
		$\int\frac{\frac{2dt}{1+t^2}}{5+4\left(\frac{1-t^2}{1+t^2}\right)}$	
		$=\int\frac{2dt}{5\left(1+t^2\right)+4\left(1-t^2\right)}$	
		$=2\int\frac{dt}{5+5t^2+4-4t^2}$	
		$=2\int\frac{dt}{t^2+9}$	1
		$=2\int\frac{dt}{t^2+3^2}$	
		$=2\frac{1}{3}\tan^{-1}\frac{t}{3}+c$	1
		$=\frac{2}{3}\tan^{-1}\left(\frac{\tan\frac{x}{2}}{3}\right)+c$	1
		--	
	c)	Evaluate $\int x\cdot\tan^{-1}x\,dx$	**04**
	Ans	$\int x\cdot\tan^{-1}x\,dx$	
		$=\tan^{-1}x\int xdx-\int\left(\left(\int xdx\right)\frac{d}{dx}\left(\tan^{-1}x\right)\right)dx$	1
		$=\frac{x^2}{2}\tan^{-1}x-\int\frac{x^2}{2}\frac{1}{x^2+1}dx$	1
		$=\frac{x^2}{2}\tan^{-1}x-\frac{1}{2}\int\frac{x^2}{x^2+1}dx$	
		$=\frac{x^2}{2}\tan^{-1}x-\frac{1}{2}\int\frac{\left(x^2+1\right)-1}{x^2+1}dx$	1
		$=\frac{x^2}{2}\tan^{-1}x-\frac{1}{2}\int\left(1-\frac{1}{x^2+1}\right)dx$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	c)	$=\frac{x^2}{2}\tan^{-1}x-\frac{1}{2}\left(x-\tan^{-1}x\right)+c$	1
		--	
	d)	Evaluate $\int\frac{\sec^2 x}{\left(1+\tan x\right)\left(2-\tan x\right)}dx$	**04**
	Ans	$\int\frac{\sec^2 x}{\left(1+\tan x\right)\left(2-\tan x\right)}dx$	
		Put $\tan x=t$	1
		$\therefore \sec^2 x\ dx=dt$	
		$\therefore \int\frac{1}{\left(1+t\right)\left(2-t\right)}dt$	
		$\frac{1}{\left(1+t\right)\left(2-t\right)}=\frac{A}{1+t}+\frac{B}{2-t}$	½
		$\therefore 1=A\left(2-t\right)+B\left(1+t\right)$	½
		$\therefore$ Put $t=-1$, $A=\frac{1}{3}$	½
		Put $t=2$, $B=\frac{1}{3}$	
		$\therefore \frac{1}{\left(1+t\right)\left(2-t\right)}=\frac{1/3}{1+t}+\frac{1/3}{2-t}$	
		$\therefore \int\frac{1}{\left(1+t\right)\left(2-t\right)}dt=\int\left(\frac{1/3}{1+t}+\frac{1/3}{2-t}\right)dt$	
		$=\frac{1}{3}\log\left(1+t\right)+\frac{1}{3}\frac{\log\left(2-t\right)}{\left(-1\right)}+c$	1
		$=\frac{1}{3}\log\left(1+\tan x\right)-\frac{1}{3}\log\left(2-\tan x\right)+c$	½
		--	
	e)	Evaluate $\int_0^5\frac{\sqrt{9-x}}{\sqrt{9-x}+\sqrt{x+4}}\ dx$	**04**

Q. No.	Sub Q.N.	Answers	Marking Scheme
4.	e) Ans	Let $I=\int_0^5 \frac{\sqrt{9-x}}{\sqrt{9-x}+\sqrt{x+4}}\,dx$ --------------------(1)	
		$I=\int_0^5 \frac{\sqrt{9-(5-x)}}{\sqrt{9-(5-x)}+\sqrt{5-x+4}}\,dx$	1
		$\therefore I=\int_0^5 \frac{\sqrt{9-5+x}}{\sqrt{\sqrt{9-5+x}}+\sqrt{9-x}}\,dx$	
		$\therefore I=\int_0^5 \frac{\sqrt{4+x}}{\sqrt{\sqrt{4+x}}+\sqrt{9-x}}\,dx$ --------------------(2)	
		add (1) and (2)	
		$\therefore I+I=\int_0^5 \frac{\sqrt{9-x}}{\sqrt{9-x}+\sqrt{x+4}}\,dx+\int_0^5 \frac{\sqrt{4+x}}{\sqrt{\sqrt{4+x}}+\sqrt{9-x}}\,dx$	1
		$\therefore 2I=\int_0^5 \frac{\sqrt{9-x}+\sqrt{4+x}}{\sqrt{9-x}+\sqrt{x+4}}\,dx$	
		$\therefore 2I=\int_0^5 1\,dx$	½
		$\therefore 2I=[x]_0^5$	1
		$\therefore 2I=5-0$	
		$\therefore I=\frac{5}{2}$	½
		--	
5.		**Attempt any TWO of the following:**	**12**
	a) Ans	Find the area bounded by curves $y^2=x$ and $x^2=y$	
		$y^2=x$ ---------(1)	
		$x^2=y$	
		$\therefore \text{eq}^n.(1)\Rightarrow x^4=x$	
		$\therefore x^4-x=0$	
		$\therefore x^3(x-1)=0$	
		$\therefore x=0,1$	1
		Area $A=\int_a^b (y_1-y_2)\,dx$	

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Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	a)	$\therefore A=\int_0^1\left(\sqrt{x}-x^2\right)dx$	1
		$\therefore A=\left(\dfrac{x^{\frac{3}{2}}}{\frac{3}{2}}-\dfrac{x^3}{3}\right)_0^1$	2
		$\therefore A=\left(\dfrac{(1)^{\frac{3}{2}}}{\frac{3}{2}}-\dfrac{(1)^3}{3}\right)-0$	1
		$\therefore A=\left(\dfrac{2}{3}-\dfrac{1}{3}\right)$	
		$\therefore A=\dfrac{1}{3}$ or 0.333	1
		--	
	b)	Attempt the following	**06**
	i)	Solve the differential equation $\dfrac{dy}{dx}+y\tan x=\cos^2 x$	**03**
	Ans	$\dfrac{dy}{dx}+y\tan x=\cos^2 x$	
		$\therefore$ Comparing with $\dfrac{dy}{dx}+Py=Q$	
		$P=\tan x$, $Q=\cos^2 x$	
		Integrating factor $IF=e^{\int \tan x dx}=e^{\log(\sec x)}=\sec x$	1
		Solution is,	
		$y.IF=\int Q.IF dx+c$	1
		$\therefore y\sec x=\int \cos^2 x\sec x\,dx$	
		$\therefore y\sec x=\int \cos^2 x\dfrac{1}{\cos x}\,dx$	
		$\therefore y\sec x=\int \cos x\,dx$	
		$\therefore y\sec x=\sin x+c$	1
		--	

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	b) ii)	Find order and degree of the differential equation $\frac{d^2y}{dx^2}=\sqrt[4]{y+\left(\frac{dy}{dx}\right)^2}$	
	Ans	$\frac{d^2y}{dx^2}=\sqrt[4]{y+\left(\frac{dy}{dx}\right)^2}$ $\left(\frac{d^2y}{dx^2}\right)^4=y+\left(\frac{dy}{dx}\right)^2$ $\therefore$ Order $=2$ Degree $=4$	1 1 1

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	c)	Acceleration of a moving particle at the end of $'t'$ seconds from the start of its motion is $(5-2t)\ m/s^2$. Find it's velocity at the end of 3 seconds and distance travelled by it during that period, if its initial velocity is 4 m/s.	**06**
	Ans	Acceleration $=5-2t$	
		$i.e.\ a=\dfrac{dv}{dt}=5-2t$	½
		$\therefore \int dv=\int(5-2t)\,dt$	1
		$\therefore v=5t-t^2+c_1$	½
		when $t=0$, $v=4$ $\therefore c_1=4$	
		$\therefore v=5t-t^2+4$	
		when $t=3$	
		$\therefore v=5(3)-(3)^2+4=10\ m/s$	1
		$\because v=\dfrac{dx}{dt}=5t-t^2+4$	
		$\therefore dx=(5t-t^2+4)dt$	½
		$\therefore \int dx=\int(5t-t^2+4)dt$	
		$\therefore x=\dfrac{5t^2}{2}-\dfrac{t^3}{3}+4t+c_2$	1
		at $t=0$, $x=0$ $\therefore c_2=0$	½
		$\therefore x=\dfrac{5t^2}{2}-\dfrac{t^3}{3}+4t$	
		at $t=3$	
		$\therefore x=\dfrac{5(3)^2}{2}-\dfrac{(3)^3}{3}+4(3)=25.5\ m$	1
		--	
6.		**Attempt any <u>TWO</u> of the following:**	
	a)	Attempt the following	
	i)	The probability that a man aged 65 will live to 75 is 0.65. What is the probability that out of 10 men which are now 65, 7 will live to 75.	
	Ans	Given $p=0.65$, $q=1-0.65=0.35$, $n=10$, $r=7$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
5.	a) i)	$\because p(r)={}^{n}C_{r}(p)^{r}(q)^{n-r}$	
		$\therefore p(7)={}^{10}C_{7}(0.65)^{7}(0.35)^{10-7}$	2
		$\therefore p(7)=0.2522$	1
	a) ii)	The probability that a bomb dropped from a Plane will strike the target is $\frac{1}{5}$.If six bombs are dropped, find the probability that exactly two will strike the target.	**03**
	Ans	Given	
		$p=\frac{1}{5}=0.2$, $q=1-0.2=0.8$	
		$n=6$, $r=2$	
		$\because p(r)={}^{n}C_{r}(p)^{r}(q)^{n-r}$	
		$\therefore p(2)={}^{6}C_{2}(0.2)^{2}(0.8)^{6-2}$	2
		$\therefore p(2)=0.2458$	1
	b)	If 2% of the electric bulbs manufactured by company are defective, find the probability that in a sample of 100 bulbs. (i) 3 bulbs are defective, (ii) At the most two bulbs will be defective.$\left(e^{-2}=0.1353\right)$	**06**
	Ans	$p=2\%=0.02$, $n=100$	
		$\therefore$ mean $m=np$	
		$\therefore m=100\times 0.02=2$	1
		Poisson's distribution is,	
		$P(r)=\frac{e^{-m}\cdot m^{r}}{r!}$	
		(i) 3 bulbs are defective $\therefore r=3$	
		$\therefore P(3)=\frac{e^{-2}(2)^{3}}{3!}$	1
		$\therefore P(3)=0.1804$	1
		(ii) At the most two bulbs will be defective $\therefore r=0,1,2$	

Q. No.	Sub Q.N.	Answers	Marking Scheme
6.	b)	$\therefore P(r)=P(0)+P(1)+P(2)$	
		$\therefore P(0)=\frac{e^{-2}(2)^0}{0!}+\frac{e^{-2}(2)^1}{1!}+\frac{e^{-2}(2)^2}{2!}$	2
		$=0.6767$	1
		--	
	c)	In a test on 2000 electric bulbs, it was found that the life of particular make was normally distributed with average life of 2040 hours and standard deviation of 60 hours. Estimate the number of bulbs likely to burn for:	**06**
		(i) between 1920 hours and 2160 hours.	
		(ii) more than 2150 hours.	
		Given that: A(2) = 0.4772	
		A(1.83) = 0.4664	
	Ans	Given $\bar{x}=2040 \quad \sigma=60 \quad N=2000$	
		$i)$ For $x=1920$	
		$z=\frac{x-\bar{x}}{\sigma}=\frac{1920-2040}{60}=-2$	½
		For $x=2160$	
		$z=\frac{x-\bar{x}}{\sigma}=\frac{2160-2040}{60}=2$	½
		$\therefore p(\text{between } 1920 \text{ and } 2160)=A(\text{ between } -2 \text{ and } 2)$	
		$=A(-2)+A(2)$	½
		$=0.4772+0.4772$	
		$=0.9544$	1
		$\therefore$ No.of $bulbs = N\cdot p$	
		$=2000\times0.9544=1908.8\approx1909$	½
		$ii)$ For $x=2150$	
		$z=\frac{x-\bar{x}}{\sigma}=\frac{2150-2040}{60}=1.83$	½
		$\therefore p(\text{more than } 2150)=A(\text{more than } 1.83)$	
		$=0.5-A(1.83)$	
		$=0.5-0.4664$	1

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6.	c)	$\therefore p(\text{more than } 2150) = 0.0336$ $\therefore \text{No. of students} = N \cdot p = 2000 \times 0.0336$ $= 67.2 \approx 67$ --- ***Important Note*** *In the solution of the question paper, wherever possible all the possible alternative methods of solution are given for the sake of convenience. Still student may follow a method other than the given herein. In such case, first see whether the method falls within the scope of the curriculum, and then only give appropriate marks in accordance with the scheme of marking.* --- ---	1 ½