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SEAT No. :

P1

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FE/Insem./APR-1
F.E.
107008 : ENGINEERING MATHEMATICS - II
(2019 Pattern) (Semester - II)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) *Attempt Q1 or Q2 and Q3 or Q4.*
2) *Use of electronic pocket calculator is allowed.*
3) *Assume suitable data, if necessary.*
4) *Neat diagram must be drawn wherever necessary.*
5) *Figures to the right indicate full marks.*

Q1) a) Solve : $\dfrac{dy}{dx}=\dfrac{x-2y+5}{2x+y-1}$ **[5]**

b) Solve : $\left(x^2y^2+5xy+2\right)ydx+\left(x^2y^2+4xy+2\right)xdy=0$ **[5]**

c) Solve : $\tan y.\dfrac{dy}{dx}+\tan x=\cos y.\cos^2 x$ **[5]**

OR

Q2) a) Solve : $\dfrac{dx}{dy}=xy+x^2y^3$ **[5]**

b) Solve : $x^2\dfrac{dy}{dx}=3x^2-2xy+1$ **[5]**

c) Solve **:** $\left[2x\ln x-xy\right]dy+\left[2y\right]dx=0$ [5]

Q3) a) A body is heated to 110 °C and placed in air at 10 °C. After one hour its temperature is 60 °C. How much time is required for it to cool to 30 °C? **[5]**

b) A constant electromotive force E volt is applied to a circuit containing a constant resistance Rohm in series with a constant inductance t henry. If the initial current is zero, show that the current builds upto half its theoretical maximum in $\dfrac{\mathrm{L}}{\mathrm{R}}(\ln 2)$ seconds. **[5]**

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c) A particle of mass m is projected upwards with velocity V_0. Assuming the air resistance k times its velocity, write the equation of motion. Show that it will reach maximum height in time $\left(\frac{m}{k}\right).\ln\left(1+\frac{kV_0}{mg}\right)$. **[5]**

OR

Q4) a) Find orthogonal trajectories of the family of curves given by $xy = C$ **[5]**

b) A circuit consists of resistance Rohm and a condenser of C farad connected to a constant electromotive force E volt. If $\frac{Q}{C}$ is the voltage of the condenser at time t after closing the circuit, show that the voltage at time t is $E\left(1-e^{-t/RC}\right)$. **[5]**

c) A pipe 10cm in diameter contains steam at 100 °C. It is covered with asbestos 5cm thick for which K=0.0006 and the outside surface is at 30°C. Find the amount of heat lost per second from a centimeter length pipe. Also find heat lost per hour from a meter length pipe. **[5]**

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P6492

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First Year Engineering

ENGINEERING MATHEMATICS - II

(2019 Pattern) (Semester - I & III) (107008)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Q.No. 1 is compulsory.*
2) *Solve Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8, or Q.9.*
3) *Neat diagrams must be drawn whenever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data if necessary.*

Q1) Write the correct option for the following multiple choice questions.

a) $\int_0^{\frac{\pi}{2}} \cos^6 x =$ **[2]**

i) $\frac{5}{16}$ ii) $\frac{5\pi}{32}$

iii) $\frac{16\pi}{10}$ iv) $\frac{5\pi}{48}$

b) The curve $y^2(x-a)=x^2(2a-x)$ is **[2]**

i) Symmetric about X - axis and net passing through origin
ii) Symmetric about Y - axis and net passing through origin
iii) Symmetric about X - axis and passing through origin
iv) Symmetric about Y - axis and passing through origin

c) The value of double integral $\int_0^1\int_0^1 \frac{1}{\sqrt{1-x^2}\sqrt{1-y^2}}dx\,dy$ is **[2]**

i) $\frac{\pi}{2}$ ii) $\frac{\pi^2}{2}$

iii) $\frac{\pi^2}{4}$ iv) $\frac{\pi^2}{16}$

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d) The Centre (C) and radius (r) of the sphere $x^2+y^2+z^2-2y-4z-11=0$ are **[2]**

i) $C\equiv(0,1,2); r=4$ ii) $C\equiv(0,-1,-2); r=2$

iii) $C\equiv(0,2,4); r=4$ iv) $C\equiv(0,1,2); r=2$

e) The number of loops in the rose curve $r = a\cos 4\theta$ are **[1]**

i) 2 ii) 4

iii) 6 iv) 8

f) $\iint\limits_R dxdy$ represents **[1]**

i) Volume ii) Centre of gravity

iii) Moment of inertia iv) Area of region R

Q2) a) If $I_n = \int_{\pi/4}^{\pi/2} \cot^n\theta\, d\theta$ prove that $I_n = \frac{1}{n-1} - I_{n-2}$. **[5]**

b) Show that $\int_0^1 x^{m-1}\left(1-x^2\right)^{n-1} dx = \frac{1}{2}\beta\left(\frac{m}{2}, n\right)$. **[5]**

c) Prove that $\int_0^1 \frac{x^a-1}{\log x}\, dx = \log(1+a), a \geq 0$. **[5]**

OR

Q3) a) If $I_n = \int_0^{\pi/2} x^n \sin x\, dx$ then prove that $I_n = n\left(\frac{\pi}{2}\right)^{n-1} - n(n-1)I_{n-2}$. **[5]**

b) Show that $\int_0^\infty e^{-h^2x^2} dx = \frac{\sqrt{\pi}}{2h}$. **[5]**

c) Show that **[5]**

$$\int_a^b e^{-x^2} dx = \frac{\sqrt{\pi}}{2}\left[erf(b) - erf(a)\right]$$

OR

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Q4) a) Trace the curve $x^2y^2 = a^2(y^2 - x^2)$. **[5]**

b) Trace the curve $r = a(1-\sin\theta)$. **[5]**

c) Find the whole length of the loop of the curve $3y^2 = x(x-1)^2$. **[5]**

OR

Q5) a) Trace the curve $y^2(2a - x) = x^3$. **[5]**

b) Trace the curve $r = a\cos 2\theta$. **[5]**

c) Trace the curve $x^{2/3} + y^{2/3} = a^{2/3}$. **[5]**

Q6) a) Prove that the two spheres $x^2 + y^2 + z^2 - 2x + 4y - 4z = 0$ and $x^2 + y^2 + z^2 + 10x + 2z + 10 = 0$ touch each other and find the co-ordinates of the point of contact. **[5]**

b) Find the equation of right circular cone whose vertex is $(1,-1,2)$, axis is the line $\frac{x-1}{2} = \frac{y+1}{1} = \frac{z-2}{-2}$ and the semi-vertical angle 45°. **[5]**

c) Find the equation of right circular cylinder of radius a whose axis passes through the origin and makes equal angles with the co-ordinate axes. **[5]**

OR

Q7) a) Show that the plane $x - 2y - 2z - 7 = 0$ touches the sphere $x^2 + y^2 + z^2 - 10y - 10z - 31 = 0$. Also find the point of contact. **[5]**

b) Find the equation of right circular cone with vertex at origin, axis the $\mathrm{Y-axis}$ and semi-vertical angle 30°. **[5]**

c) Find the equation of right circular cylinder of radius $\sqrt{6}$ whose axis is the line $\frac{x}{1} = \frac{y}{-1} = \frac{z}{1}$. **[5]**

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Q8) a) Change the order of integration and evaluate $\int_0^{\pi}\int_x^{\pi}\frac{\sin y}{y}\,dx\,dy$. **[5]**

b) Find the area of one loop of $r = a\sin 2\theta$. **[5]**

c) Find the moment of inertia of one loop of the lemniscate $r^2 = a^2\cos 2\theta$ about initial line. Given that $\rho = \frac{2m}{a^2}, m$ is the mass of loop of lemniscate. **[5]**

OR

Q9) a) Evaluate $\iint_1 y\,dx\,dy$ over the region enclosed by the parabola $x^2 = y$, and the line $y = x + 2$. **[5]**

b) Evaluate $\iiint x^2 yz\,dx\,dy\,dz$, throughout the volume bounded by the plane $x = 0, y = 0, z = 0$ $\frac{x}{a}+\frac{y}{b}+\frac{z}{c}=1$. **[5]**

c) Find the y - coordinate of the centre of gravity of the area bounded by $r = a\sin\theta$ and $r = 2a\sin\theta$. Given that the area bounded by these curves is $\frac{3\pi a^2}{4}$. **[5]**

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F.E.

ENGINEERING MATHEMATICS-II

(2019 Pattern) (Semester - I/II) (107008)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Q. No.1 is compulsory.*
2) *Solve Q.2 or Q.3, Q.4 or Q.5, Q.6 or Q.7, Q.8 or Q.9.*
3) *Neat diagrams must be drawn wherver necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of electronic pocket calculator is allowed.*
6) *Assume suitable data, if necessary.*

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Q1) Write the correct option for the following multiple choice questions

a) $\int_0^{\pi/2} \sin^4 + dt =$ **[2]**

i) $\frac{3\pi}{16}$ ii) $\frac{3}{8}$

iii) $\frac{3}{16}$ iv) $\frac{3\pi}{8}$

b) The equation of the tangent to the curve $y(1+x^2) = x$ at origin, if exist is **[2]**

i) X=0 ii) Y=0

iii) $x = 1, x = -1$ iv) $y = x$

c) The value of double integration $\int_0^1\int_0^1 \frac{1}{1+x^2} \cdot \frac{1}{1+y^2} dxdy =$ **[2]**

i) $\frac{\pi}{2}$ ii) $\frac{\pi^2}{2}$

iii) $\frac{\pi}{4}$ iv) $\frac{\pi^2}{8}$

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d) Centre (C) of sphere $x^2 + y^2 + z^2 - 2z = 4$ is **[2]**

i) $C \equiv (0,0,0)$ ii) $C \equiv (0,0,1)$

iii) $C \equiv (0,1,0)$ iv) $C \equiv (1,0,0)$

e) The curve $r = 2a\sin\theta$ is symmetrical about **[1]**

i) Pole ii) $\theta = 0$

iii) $\theta = \dfrac{\pi}{2}$ iv) $\theta = \dfrac{\pi}{4}$

f) $\iiint_V dxdydz$ represents **[1]**

i) Area ii) Mass

iii) Mean Value iv) Volume

Q2) a) If $I_n = \int_0^{\frac{\pi}{4}} sec^n\theta \, d\theta$, then prove that $I_n = \dfrac{\left(\sqrt{2}\right)^{n-2}}{n-1} + \dfrac{n-2}{n-1} I_{n-2}$ **[5]**

b) Evaluate $\int_2^5 (x-2)^3 (5-x)^2 dx$ **[5]**

c) Using DUIS, prove that $\int_0^\infty \dfrac{e^{-x} - e^{-ax}}{x\sec x} dx = \dfrac{1}{2}\log\left(\dfrac{a^2+1}{2}\right), a > 0$ **[5]**

OR

Q3) a) Evaluate

i) $\int_0^{2\pi} \sin^2\dfrac{\theta}{2}\cos^{10}\dfrac{\theta}{2} \, d\theta$ **[3]**

ii) $\int_{-\frac{\pi}{2}}^{\frac{\pi}{2}} \cos^4 t \;\, dt$ **[2]**

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b) Evaluate : $\int_0^1 (x\log x)^4\, dx$ **[5]**

c) Prove that: $\frac{1}{x}\frac{d}{da}erf_c(ax) = -\frac{1}{a}\frac{d}{dx}erf(ax)$ **[5]**

Q4) a) Trace the curve $x^2y^2 = a^2(y^2 - x^2)$. **[5]**

b) Trace the curve $r = a(1+\cos\theta)$. **[5]**

c) Find the are length of Astroid $x^{2/3} + y^{2/3} = a^{2/3}$ **[5]**

OR

Q5) a) Trace the curve $x^3 + y^3 = 3axy$. **[5]**

b) Trace the curve $r = a\cos 2\theta$ **[5]**

c) Trace the curve $x = a(t+\sin t),\ y = a(1+\cos t)$. **[5]**

Q6) a) Show that the plane $x-2y-2z=7$ touches the sphere $x^2+y^2+z^2-10y-10z-31=0$. Also find the point of contact. **[5]**

b) Find the equation of right circular cone whose vertex is at origin, whose axis is the line $\frac{x}{1}=\frac{y}{2}=\frac{8}{3}$ and which has a semi-vertical angle of 60°. **[5]**

c) Find the equation of right circular cylinder of radius 3 and axis is the line $\frac{x-1}{2}=\frac{y-2}{1}=\frac{z-3}{2}$. **[5]**

OR

Q7) a) Show that the two spheres: $x^2+y^2+z^2=25$ and $x^2+y^2+z^2-18x-24y-40z+225=0$ touches externally. Also find the point of contact. **[5]**

b) Find the equation of right circular cone whose vertex is at (0,0,10), axis is the Z-axis and the semi-vertical angle is $\cos^{-1}\left(\frac{2}{\sqrt{5}}\right)$ **[5]**

c) Find the equation of right circular cylinder of radius $\sqrt{6}$, whose axis passes through the origin and has direction cosines $\frac{1}{\sqrt{3}},\frac{-1}{\sqrt{3}},\frac{1}{\sqrt{3}}$. **[5]**

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Q8) a) Evaluate $\iint\limits_R xy\,dx\,dy$, where R is $x^2 = y, y^2 = -x$. **[5]**

b) Find area of cardioide $r = a(1 - \cos\theta)$ using double integration. **[5]**

c) Find the moment of inertia of one loop of the lemniscate $r^2 = a^2 \cos 2\theta$ about initial line. Givenl that density $\rho = \dfrac{2m}{a^2}$, m is a mass of the area. **[5]**

OR

Q9) a) Change order of integration $\int_0^5 \int_{2-x}^{2+x} f(x,y)\,dxdy$. **[5]**

b) Find the volume bounded by the cone $x^2 + y^2 = z^2$ and paraboloid $x^2 + y^2 = z$. **[5]**

c) Find the x - co-ordinate of centre of gravity of one loop of $r = a\cos 2\theta$, which is in the first quadrant, given that area of loop is $A = \dfrac{\pi a^2}{8}$. **[5]**

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