BAS
(Annual-2016) 44578

Time Allowed: 3 Hours
Maximum Marks: 100

oject: A Course of Mathematics
per: A
te: **Attempt Six questions in all by selecting Three questions from each section.**

SECTION-I

(a) Define continuous function in term of $(\delta-\varepsilon)$ form and discuss the continuity of $f(x)=x-[x],\ x\in R$, for integral ues of $\mathbb{R}$. 3+6/13

Define least upper bound and prove that the set $S=\{x:x^2<2\}$ has least upper bound $=\sqrt{2}$. 2+6/11

2(a) If u is a derivable function of v and v is a derivable function of x, then prove that $\frac{du}{dx}=\frac{du}{dv}\cdot\frac{dv}{dx}$. 9

b) If $y(x)=e^{ax}x^2$, find a formula for $y^{(n)}(x)$. 8/18

Q.3(a) If f is differentiable on $[a,b]$ and f' decreases strictly on $[a,b]$, prove that $f'(b)<\frac{f(b)-f(a)}{b-a}<f'(a)$. How is his result modified if f' increases strictly on $[a,b]$? Hence show that if $f(x)=\sin x,\quad a=\frac{\pi}{3},\quad b=\frac{61\pi}{180}$ then $\sin 61^\circ-\sin 60^\circ<0.0088$. 9

(b) Evaluate the following limit: $\lim_{x\to 1}\frac{(1-x^{m+1})(1-x^{m+2})(1-x^{m+3})\ldots(1-x^{m+n})}{(1-x)(1-x^2)(1-x^3)\ldots(1-x^n)}$. 8

Q.4(a) Describe the geometrical significance of the derivative of the radius vector with respect to the polar angle. 9

(b) Show that Pedal equation of the ellipse $\frac{x^2}{a^2}+\frac{y^2}{b^2}=1$ is $\frac{1}{p^2}=\frac{1}{a^2}+\frac{1}{b^2}-\frac{r^2}{a^2b^2}$. 8

Q.5(a) Show that the maximum value of $(\frac{1}{x})^x$ is $(e)^{1/e}$. 8

(b) If $y(x)=\{x+\sqrt{1+x^2}\}^m$, prove that $(1+x^2)y''(x)+xy'(x)-m^2y(x)=0$ and 9/19
$(1-x^2)y^{(n+2)}(x)+(2n+1)xy^{(n+1)}(x)+(n^2-m^2)y^{(n)}(x)=0$. 9

Q.6(a) Find the centre of curvature of the astroid $x^{2/3}+y^{2/3}=a^{2/3}$. 8

(b) The normal to a given curve is a tangent to its evolute. 9

SECTION-II

Q.7(a) State and prove the fundamental theorem of the integral calculus. 8

(b) Prove that $\int_0^\infty\frac{\ell n(1+x^2)}{1+x^2}dx=\pi\ell n2$. 8

Q.8(a) Define improper integral and determine the convergence or divergence of the following improper integral and evaluate. The convergent integral $\int_0^\infty e^{-x}x^5dx$. 2+7/9

(b) Evaluate $\int\frac{x^2}{(1+x^2)^3}dx$. 8/18

Q.9(a) Evaluate $\int\frac{x+\sin x}{1+\cos x}dx$. 8/2

(b) (i) If $f(x)$ and $g(x)$ are two antiderivatives of $\phi(x)$ then $f(x)$ and $g(x)$ must differ by a constant. 4/1

(ii) Evaluate $\int\frac{\sqrt{9x^2-1}}{x}dx$. 4/4

Q.10(a) Show that the intrinsic equation of the semicubical parabola $ay^2=x^3$, taking the cusp as the fixed point is $27S=8a(\sec^2\psi-1)$. 8

(b) Find the area of the region included between the cardiod $r=2a(1+\cos\theta)$ and the circle $r=6a\cos\theta$. 8

Q.11(a) Assuming that the area of an ellipse with semi axes a and b is πab, compute the volume of the ellipsoid $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$. 8

(b) Find the Fourier series representing the function $f(x)=|x|,\ -\pi\le x\le\pi$. 8

Q.12(a) Determine whether the series $\sum_{n=1}^\infty\frac{\arctan n}{1+n^2}$ converges or diverges. 8

(b) Apply any appropriate test to determine the convergence or divergence of the series $\sum_{n=1}^\infty\frac{(2n+1)!}{n^2(n+1)!}$. 8

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