Engineering Mathematics-II (BAS-203)
Unit 3 Sequence and Series

[redacted]

Que1. Find the Fourier constant a_0

$(i)\ f(x) = x^2, -\pi \le x \le \pi$ **[2018-19]** $(ii)\ f(x) = \begin{cases} 0, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ **[2015-16]**

Que2. Write the Dirichlet's condition for Fourier series **[2016-17]**

Que3. If $f(x) = \left(\frac{\pi - x}{2}\right)^2, 0 < x < 2\pi$. Show that $f(x) = \frac{\pi^2}{12} + \sum_{n=1}^{\infty} \frac{\cos nx}{n^2}$

Que4. Obtain a Fourier Series of f(x)=$\left(\frac{\pi - x}{2}\right)$ expansion of the function $f(x)$ in the interval of $(0,2\pi)$ and hence Show that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots = \frac{\pi}{4}$

Que5. Find the Fourier series of the following function in interval $-\pi \le x \le \pi$

$(i) f(x) = x\sin x$ **[2018-19]** $(ii) f(x) = x\cos x$ $(iii) f(x) = x^3$ **[2015-16]**

Que6. Find the Fourier Series to represent the function $f(x)$ given by

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

Hence Show that $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots = \frac{\pi}{4}$ **[2015-16]**

Que7. Find the Fourier series of $f(x) = \pi - x,\ 0 \le x \le 2\pi$

Que8. Find the Fourier Series for the function $f(x) = \begin{cases} -1, -\pi < x < -\frac{\pi}{2} \\ 0, -\frac{\pi}{2} < x < \frac{\pi}{2} \\ 1, \frac{\pi}{2} < x < \pi \end{cases}$

Que9. Find the Fourier series expansion of the function $f(x) = x + \frac{x^2}{4}$ in the interval $(-\pi, \pi)$.

Que10. Obtain a Fourier series expansion of the function

$(i)\ f(x) = e^{-x}, 0 < x < 2\pi$ $(ii)\ f(x) = x, 0 < x < 2\pi$

Que11. Find the Fourier Series for $f(x)$ given by

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

Hence Show that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$ **[2017-18], [2016-17]**

Que12. Obtain the Fourier Series for the function $f(x) = \begin{cases} 1 + \frac{2x}{\pi}, & -\pi < x < 0 \\ 1 - \frac{2x}{\pi}, & 0 < x < \pi \end{cases}$ **[2021-22]**

Hence deduce that $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$

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Que1. Find the Fourier constant

$(i)\ f(x) = |x|$ in interval $(-2, 2)$ **[2016-17]** $(ii)\ f(x) = 1 + |x|$ in interval $(-3, 3)$ **[2021-22]**

Que2. Find the Fourier series to represent the function $f(t)$ given by **[2015-16]**

$$f(t) = \begin{cases} t & , \quad 0 < t < 1 \\ (1-t) & , \quad 1 < x < 2 \end{cases}$$

Que3. Obtain the Fourier series for the function $f(x) = \begin{cases} 1 + \frac{2x}{l} & , -l < x < 0 \\ 1 - \frac{2x}{l}, & 0 < x < l \end{cases}$

Que4. Find the Fourier series of the following function in interval $-2 < x < 2$

$(i) f(x) = |x| \quad (ii) f(x) = 4 - x^2 \quad (iii) f(x) = \begin{cases} 0 & , -2 < x < 0 \\ 1 & , \ 0 < x < 2 \end{cases}$

Que5. Obtain a Fourier series expansion of the function $f(x) = e^{-x}, -l < x < l$

Que6. Obtain the Fourier Series for the function $f(x) = \begin{cases} \pi x & , \ 0 < x < 1 \\ \pi(2-x), & 1 < x < 2 \end{cases}$

Que7. If $f(x) = 1$, in interval $(0, \pi)$ is expanded in half range cosine series then find the value of a_0.

Que8. Find the half range cosine series of the following function

$(i) f(x) = 2x - 1, 0 < x < 1$ **[2016-17]** $(ii)\ f(x) = x(\pi - x), 0 < x < \pi$ **[2015-16]**

$(iii) f(x) = \sin\left(\frac{\pi x}{l}\right), 0 < x < l$ $(iv)\ f(t) = \begin{cases} 2t & , 0 < t < 1 \\ 2(2-t), & 1 < t < 2 \end{cases}$ **[2017-18]**

Que9. Find the half range sine series of the following function

$(i) f(x) = x - x^2, 0 < x < 1$ **[2016-17]** $(ii)\ f(t) = \begin{cases} t, & 0 < t < 2 \\ 4 - t, & 2 < t < 4 \end{cases}$ **[2018-19]**

Que10. Find the half range sine series of the function $f(x) = \begin{cases} \omega x, & 0 \le x \le \frac{l}{2} \\ \omega(l-x), & \frac{l}{2} \le x \le l \end{cases}$

Hence obtain the sum of series $\frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \cdots = \frac{\pi^2}{8}$

Que11. Find the series of cosine of multiple of x which will represents $x \sin x$ in the interval $(0, \pi)$ and Show that $\frac{1}{1.3} - \frac{1}{3.5} + \frac{1}{5.7} - \cdots = \frac{\pi - 2}{8}$

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Que 1 Discuss the convergence of the sequences $\{a_n\}$ where

(i) $a_n = \frac{n+1}{n}$ (ii) $a_n = \frac{1}{n}$ (iii) $a_n = \frac{2n}{n^2+1}$ **[2018-19]**

Que 2 Test the series $\sum_{n=1}^{\infty} \frac{1}{n} \sin \frac{1}{n}$ **[2021-22]**

Que 3 Examine the nature of series 6-5-1+6-5-1+6-5-1.....$+\infty$.

Que 4 Examine the nature of series $1 + 2 + 3 + \cdots + n + \cdots \infty$

Que 5 Test the convergence of series $1 + \frac{1}{2} + \frac{1}{4} + \frac{1}{8} + \cdots \infty$.

Que 6 Discuss the nature of series 2-2+2-2+.....$+\infty$.

Que 7 Test the Convergence of the series $\frac{1}{\sqrt{1}+\sqrt{2}} + \frac{1}{\sqrt{2}+\sqrt{3}} + \frac{1}{\sqrt{3}+\sqrt{4}} + \cdots$

Que 8 Test the Convergence of the series $\frac{1}{1+2^{-1}} + \frac{2}{1+2^{-2}} + \frac{3}{1+2^{-3}} + \cdots$

Que 9 Test the Convergence of the series $\frac{\sqrt{2}-1}{3^3-1} + \frac{\sqrt{3}-1}{4^3-1} + \frac{\sqrt{4}-1}{5^3-1} + \cdots$

Que 10 Test the Convergence of the series $\frac{2^q}{1^p} + \frac{3^q}{2^p} + \frac{4^q}{3^p} + \cdots$

Que 11 Test the Convergence of the series whose nth term is

$(i) \sum_{n=1}^{\infty} \frac{2n^2+3n}{5+n^5}$ $(ii) \frac{n^2}{2^n}$ $(iii) \sum(\sqrt[3]{n^3+1} - n)$ $(iv) \sum\left(\frac{3n-1}{2^n}\right)$ $(v) \sum \frac{n!}{n^n}$ $(vi) \sum \frac{\sqrt{n}}{\sqrt{n^2+1}} x^n \ (x > 0)$

Que 12 Discuss the Convergence of the series $\frac{x}{1.2} + \frac{x^2}{3.4} + \frac{x^3}{5.6} + \frac{x^4}{7.8} + \cdots$. **[2021-22]**

Que 13 State D' Alembert test. Test the series $1 + \frac{x}{2} + \frac{x^2}{5} + \frac{x^3}{10} + \cdots \ldots \ldots$ **[2018-19]**

Que 14 Define Raabe's Test. Discuss the Convergence of the series $\frac{x}{1} + \frac{1}{2}\frac{x^3}{3} + \frac{1}{2}\frac{3}{4}\frac{x^5}{5} + \frac{1}{2}\frac{3}{4}\frac{5}{6}\frac{x^7}{7} + \ldots (x >$

Que 15 Discuss the Convergence of the series $1 + \frac{1}{2}x + \frac{1}{2}\frac{3}{4}x^2 + \frac{1}{2}\frac{3}{4}\frac{5}{6}x^3 + \ldots (x > 0)$

Que 16 Discuss the Convergence of the series $\frac{1}{2}x^2 + \frac{9}{8}x^3 + x^4 + \frac{25}{32}x^5 + \ldots \infty$

Que 17 Show that the series $\frac{1}{x} + \frac{2!}{x(x+1)} + \frac{3!}{x(x+1)(x+2)} + \ldots \infty$ converges if $x > 2$ & diverges if $x < 2$

Que 18 Discuss the Convergence of the series $\frac{x^2}{2\log 2} + \frac{x^3}{3\log 3} + \frac{x^4}{4\log 4} + \ldots\ldots$

Que 19 Test the Convergence of the series $\frac{1^2}{4^2} + \frac{1^2}{4^2}\frac{5^2}{8^2} + \frac{1^2}{4^2}\frac{5^2}{8^2}\frac{9^2}{12^2} + \frac{1^2}{4^2}\frac{5^2}{8^2}\frac{9^2}{12^2}\frac{13^2}{16^2}$

Que 20 Test the Convergence of the series

$$1 + \frac{\alpha.\beta}{1.\gamma}x + \frac{\alpha(\alpha+1)\beta(\beta+1)}{1.2\gamma(\gamma+1)}x^2 + \frac{\alpha(\alpha+1)(\alpha+2)\beta(\beta+1)(\beta+2)}{1.2.3\gamma(\gamma+1)(\gamma+2)}x^3 + \cdots$$