	P.R.Government College (Autonomous) KAKINADA	Program&Semester FOR ALL MAJOR SUBJECTS (I Sem)			
CourseCode **MAT 102**	**TITLE OF THE COURSE ADVANCES IN MATHEMATICAL, PHYSICAL AND CHEMICAL SCIENCES**				
Teaching	HoursAllocated:60(**Theory**)	L	T	P	C
Pre-requisites:		5	-	-	4

Course Objective:

The objective of this course is to provide students with an in-depth understanding of the recent advances and cutting-edge research in mathematical, physical, and chemical sciences. The course aims to broaden students' knowledge beyond the foundational concepts and expose them to the latest developments in these disciplines, fostering critical thinking, research skills, and the ability to contribute to scientific advancements.

Learning outcomes:

1. Explore the applications of mathematics in various fields of physics and chemistry, to understand how mathematical concepts are used to model and solve real-world problems.
2. To Explain the basic principles and concepts underlying a broad range of fundamental areas of physics and to Connect their knowledge of physics to everyday situations.
3. Understand the different sources of renewable energy and their generation processes and advances in nanomaterials and their properties, with a focus on quantum dots. To study the emerging field of quantum communication and its potential applications. To gain an understanding of the principles of biophysics in studying biological systems. Explore the properties and applications of shape memory materials.
3. Understand the principles and techniques used in computer-aided drug design and drug delivery systems, to understand the fabrication techniques and working principles of nanosensors. Explore the effects of chemical pollutants on ecosystems and human health.
4. Understand the interplay and connections between mathematics, physics, and chemistry in various advanced applications. Recognize how mathematical models and physical and chemical principles can be used to explain and predict phenomena in different contexts.

5 Understand and convert between different number systems, such as binary, octal, decimal, and hexadecimal. Differentiate between analog and digital signals and understand their characteristics.Gain knowledge of different types of transmission media, such as wired (e.g., copper cables, fiber optics) and wireless (e.g., radio waves, microwave, satellite)..

UNIT I: ADVANCES IN BASICS MATHEMATICS

Straight Lines: Different forms – Reduction of general equation into various forms –Point of intersection of two straight lines

Limits and Differentiation: Standard limits – Derivative of a function –Problems on product rule and quotient rule

Integration: Integration as a reverse process of differentiation – Basic methods of integration

Matrices: Types of matrices – Scalar multiple of a matrix – Multiplication of matrices – Transpose of a matrix and determinants

UNIT II: ADVANCES IN PHYSICS:

Renewable energy: Generation, energy storage, and energy-efficient materials and devices. Recent advances in the field of nanotechnology: Quantum dots, Quantum Communication- recent advances in biophysics- recent advances in medical physics- Shape Memory Materials.

UNIT III: ADVANCES IN CHEMISTRY:

Computer aided drug design and delivery, nano sensors, Chemical Biology, impact of chemical pollutants on ecosystems and human health, Dye removal - Catalysis method

UNIT IV: ADVANCED APPLICATIONS OF MATHEMATICS, PHYSICS & CHEMISTRY

Mathematical Modelling applications in physics and chemistry

Application of Renewable energy: Grid Integration and Smart Grids, Application of nanotechnology: Nanomedicine,

Application of biophysics: Biophysical Imaging, Biomechanics, Neurophysics,

Application of medical physics: Radiation Therapy, Nuclear medicine.

Solid waste management, Environmental remediation- Green Technology, Water treatment.

UNIT V: Advanced Applications of computer Science

Number System-Binary, Octal, decimal, and Hexadecimal, Signals-Analog, Digital, Modem, Codec, Multiplexing, Transmission media, error detection and correction- Parity check and CRC, Networking devices- Repeater, hub, bridge, switch, router, gateway.

Recommended books:

1. Coordinate Geometry by S.L.Lony, Arihant Publications
2. Calculus by Thomas and Finny, Pearson Publications
3. Matrices by A.R.Vasishtha and A.K.Vasishtha, Krishna Prakashan Media(P)Ltd.
4. "Renewable Energy: Power for a Sustainable Future" by Godfrey Boyle
5. "Energy Storage: A Nontechnical Guide" by Richard Baxter
6. "Nanotechnology: Principles and Applications" by Sulabha K. Kulkarni and Raghvendra A.Bohara
7. "Biophysics: An Introduction" by Rodney Cotterill
8. "Medical Physics: Imaging" by James G. Webster

9. "Shape Memory Alloys: Properties and Applications" by Dimitris C. Lagoudas
10. Nano materials and applications by M.N.Borah
11. Environmental Chemistry by Anil.K.D.E.
12. Digital Logic Design by Morris Mano
13. Data Communication & Networking by Bahrouz Forouzan.

PITHAPUR RAJAHS GOVERNMENT COLLEGE (A):KAKINADA

DEPARTMENT OF MATHEMATICS

Advances in Mathematical, Physical and Chemical Sciences

Question Bank

Limits

Multiple choice questions

1) $\lim_{X\to 0} \frac{sinx}{x} =$ [b]

a) 0 b) 1 c) -1 d) 2

2) $\lim_{x\to\infty} \frac{\log x}{x} =$ [a]

a) 0 b) -1 c) 1 d)∞

3) $\lim_{x\to 1} \frac{x^2-1}{x-1} =$ [c]

a) 0 b)1 c) 2 d)∞

4) Find the value of $\lim_{x\to\infty} \frac{5x^2+3x+1}{3x^{2+2x+4}} =$ [a]

a) $\frac{5}{3}$ b) $\frac{3}{2}$ c) $\frac{1}{4}$ d) None of this

5) $\lim_{x\to a} \frac{x^n-a^n}{x-a} =$ [a]

a) na^{n-1} b) ax^{n-1} c) ∞ d) None of this

6) Evaluate $\lim_{\theta\to 0} \frac{\tan\theta}{\theta} =$ [a]

a) 1 b) 2 c)3 d)∞

Fill in the blanks

1. $If\ \lim_{x\to a} f(x)=l\ and\ \lim_{x\to a} f(x)=m\ then\ \lim_{x\to a} f(x)\cdot g(x)$ Is ----------

$Sol: \lim_{x\to a} f(x)\cdot g(x) = \lim_{x\to a} f(x)\cdot \lim_{x\to a} g(x) = lm$

2.*The limit of constant function is* ----------

Sol: $\lim_{x\to a} C = constant$

3. *If* $\lim_{x\to a} f(x)=l$ *then* $\lim_{x\to a} kf(x)$ *is* ----------

Sol: $\lim_{x\to a} k\, f(x) = k\lim_{x\to a} f(x) = kl$

4. $\lim_{x\to 0} \frac{Tanx}{x}$ *is*----------

Sol: $\lim_{x\to 0} \frac{Tan\, x}{x} = 1$

5. $\lim_{x\to 2} \frac{x^2-3x+2}{x-2}$ =----------

Sol: $\lim_{x\to 2} \frac{x^2-3x+2}{x-2} = \lim_{x\to 2} \frac{2^2-3\times 2+2}{2-2} = \frac{0}{0}\, form = \lim_{x\to 2} \frac{2x-3}{1} = 1$

Match the following

Group-A		Group-B
1. $\lim_{x\to 0} \cos x$	[c]	a) 1
2. $\lim_{x\to 0} \frac{\sin x}{x}$	[a]	b) 4
3. $\lim_{x\to 0} e^{\frac{1}{x}}$	[d]	c) 0
4. $\lim_{x\to 2}(x+2)$	[b]	d) ∞

□□□□□□□□□□□□□□□□

Multiple choice questions

1) $\frac{d}{dx}(x^2)$ = [d]

a) 3x b) $4x^2$ c) 5x d)2x

2) $\frac{d}{dx}\left(\frac{1}{x^7}\right) =$ [a]

a) $\frac{-7}{x^8}$ b) $\frac{-8}{x^7}$ c) $\frac{-6}{x^8}$ d) None

3). □□ (□) = □²□□□□ □ℎ □□ □¹(□)□□ [□]

$a)\ 2x.sinx$ $b)\ 2x.cosx$ $c)\ x^2cosx$ $d)\ 2xsinx + x^2cosx$

4)For the function u(x)=e^x and v(x)=log x what is $\frac{d}{dx}$(u+v) is [a]

a) $e^x + \frac{1}{X}$ b) $e^x - \frac{1}{X}$ c) $e^x . \frac{1}{X}$ d) log x

Fill in the blanks

1. $\frac{d}{dx}(u(x).v(x))$ =----------

Sol: $u^1(x)v(x)+v(x)u^1(x)$

2. $\frac{d}{dx}(e^{2x})$ = ----------

Sol: $2e^{2x}$

3.*The derivative of a constant function is*--------

Sol: $\frac{d}{dx}(C) = 0$

4. $\frac{d}{dx}(\frac{1}{x})$=---------

Sol: $-\frac{1}{x^2}$)

5.*The derivative of a function* $\frac{u(x)}{v(x)}$ *is*----------

Sol: $\frac{v(x)u^1(x)-u(x)v^1(x)}{v^2(x)}$

Match the following

Group-A		Group-B
1. $\frac{d}{dx}(12x)$	[c]	a) secx.tanx
2. $\frac{d}{dx}(sinx)$	[e]	b) Sce²x

3. $\frac{d}{dx}(e^{2x})$ [d] c) 12

4. $\frac{d}{dx}(Tanx)$ [b] d) $2e^{2x}$

5. $\frac{d}{dx}(secx)$ [a] d) Cosx

Straight Lines

Multiple choice questions

1. *Given the equations of a line slope−intercept form y=mx+b, what does m represent?* [*c*]

a)x−intercept b)y−intercept c)Slope d)Distance

2. *If two lines are parallel, what can besaid about their slopes ?* [*a*]

a) They are equal *b) They are perpendicular*

c) They have opposite slopes *d) They have no relationship*

3. *Which of the following is the equations of a vertical lines?* [*b*]

a) $y=2x+3$ *b)* $x=4$ *c)* $y=-3x+4$ *d)* $y=x^2$

4. *If two lines are perpendicular, what is the relationship between their slopes?* [*c*]

a) They are equal *b) They are parallel*

c)The product of their slopes is−1 *d) They have the same y−intercept*

5. *What is the slope of horizontal line?* [*a*]

a) 0 *b)* 1 *c) Undefined* *d) Infinite*

6. *For the point* (2,5) *and* (6,9) *what is the slope of the line passing through them?* [*a*]

a) 1 *b)* 2 *c)* 4 *d)* 0.5

Fill in the blanks

1. *The slope intercept form of a straight line is----*

Sol: $y = mx+c$

2.$The\ point-slope\ form\ of\ a\ straight\ line\ is----$

Sol: $y-y_1 = m(x-x_1)$

3.$The\ standard\ form\ of\ a\ straight\ line\ is-----$

Sol: $ax+by+c=0$

4. $The\ slope\ of\ the\ horizontal\ line\ is----$

Sol: 0

5.$The\ lines\ are\ perpendicular\ if\ the\ product\ of\ their\ slopes\ is---$

Sol: -1

Match the following

Group-A		Group-B
1. $Slope\ intercept\ form$	[c]	$a)\ ax+by+c = 0\ where\ a_2+b_2 \neq 0$
2. $Intercept\ form$	[f]	$b)\ y-y_1 = m(x-x_1)$
3. $Two\ point\ form$	[d]	$c)\ y = mx+c$
4. $One\ point\ form$	[b]	$d)\ y-y_1 = \{y_2-y_1/x_2-x_1\}(x-x_1)$
5. $Standrad\ form$	[a]	$e)\ xcos\alpha+ysin\alpha = p$
6. $Normal\ form$	[e]	$f)\ xa+yb = 1$

Integration

Multiple choice questions

1) What is the integration of the constant function f(x) =5---------- [d]

a) 5x b) 5 c) 0 d) 5x+c

2) What is $\int x^n dx$ where n is constant [a]

$\boldsymbol{a)}\ \frac{x^{n+1}}{n+1} + c$ b) nx^{n-1} c) $x^{n+1}+c$ d) $\frac{x^{n+1}}{n} + c$

3) $\int e^x dx =$ [a]

a).$e^x + c$ b) $\log x + C$ c) $\cos x + c$ d)$\sin x + c$

4) $\int \cos x \, dx =$ [b]

a) $\sin x + c$ b) $-\sin x + c$ c)$\cos x + c$ d)$-\cos x + c$

5) $\int \frac{1}{x^2} dx =$ [c]

a) $\frac{1}{x} + c$ b) $\frac{1}{x^3} + c$ c)$-\frac{1}{x} + c$ d)$-\frac{1}{x^3} + c$

Fill in the blanks

1. $If\ F^1(x)=f(x)\ then \int f(x)dx=----$

   Sol: $F(x)+c$

2. $\int Cdx(where\ c\ is\ constant\ )$ = -------

   Sol: $Cx+c$

3. $\int Sinxdx$ =--------

   Sol: $-Cosx+c$

4. $\int U(x)V(x)dx$ = --------

   Sol: $U(x)\int V(x)dx-\int[U^1(x)\int V(x)dx]\,dx+c$

5. $\int e^x\,(f(x) + f^1(x))\,dx$ = ----------

   Sol: $e^x f(x) + c$

Match the following

	Group-A		Group-B
1.	$\int 9x^2dx$	[c]	a) $\frac{x^n+1}{n+1}+C$
2.	$\int \sin xdx$	[e]	b) $\frac{x2}{2}+C$
3.	$\int \cos xdx$	[d]	c) $3x^3+C$
4.	$\int xdx$	[b]	d) sinx+C
5.	$\int x^n dx$	[a]	e) $-\cos x+C$

Matrices

Multiple choice questions

1). If A is a non-singular matrix then $A^{-1} =$ [b]

a) $\frac{\det A}{adj\ A}$ b) $\frac{Adj\ A}{detA}$ c) $\frac{AdjA}{A^T}$ d) $\frac{detA}{A^T}$

2) What is the transpose of 2x3 matrixes is [b]

a) 2x3 b) 3x2 c)2x2 d) 3x3

3). The determinant of 2x2 matrixes $\begin{pmatrix} a & b \\ c & d \end{pmatrix}$ is [a]

a) ad-bc b) ac-bd c) ad+cd d) (a+d) (b+c)

4). If $\begin{pmatrix} x-3 & 2y-8 \\ z+2 & 6 \end{pmatrix} = \begin{pmatrix} 5 & 2 \\ -2 & a-4 \end{pmatrix}$ then the value of x+y = [c]

a) 8 b) 5 c)13 d) 3

5).$(AB)^{-1} =$ [d]

a) A+B b) A-B c) $A^{-1}B^{-1}$ d) $B^{-1}A^{-1}$

6). If A^T= A then A is called [a]

a) symmetric b) skew symmetric c) determinant d) none

7). det (A+B) = [c]

a) $\frac{\det A}{detb}$ b) detA-detB c) detA+detB d) none

Fill in the blanks

1.*The transpose of a matrix is obtained by interchange its----and----*

Sol: *rows and columns*

2.*The identity matrix is square matrix with----along the main diagonal and----else where.*

Sol: *ones, zeros*

3. $The\ \det of\ \begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix} =$

Sol: 1

4. $Inverse\ of\ a\ matrix\ exists\ if determinant\ of\ that\ matrix\ is$-----

Sol: $not\ equal\ to\ zero$

5. $\det(A^T) =$

Sol: $detA$

Match the following

$If\ A=\begin{bmatrix} 1 & 2 \\ 0 & -3 \end{bmatrix}, B=\begin{bmatrix} -4 & 1 \\ 2 & 5 \end{bmatrix}, C=\begin{bmatrix} 2 & 0 \\ 1 & 1 \end{bmatrix} then\ match\ the\ following$

Group-A		Group-B
1. A.B	[a]	a) $\begin{bmatrix} 6 & 11 \\ -2 & -15 \end{bmatrix}$
2. B - C	[b]	b) $\begin{bmatrix} -6 & 1 \\ 1 & 4 \end{bmatrix}$
3. 3A	[c]	c) $\begin{bmatrix} 3 & 6 \\ 0 & -9 \end{bmatrix}$
4. B.C	[e]	d) $\begin{bmatrix} 1 & -4 \\ 0 & 9 \end{bmatrix}$
5. A^2	[d]	e) $\begin{bmatrix} -7 & 1 \\ 9 & 5 \end{bmatrix}$

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