SYLLABUS

RK UNIVERSITY

Course Title	**Mathematics**	
Course Code	BMT101	
Course Credit	Lecture	: 5
	Practical	: 3
	Total	: 8

Course Objectives

On the completion of the course, students will be able to:

- Understand the fundamentals of mathematics.

Detailed Syllabus

Sr. No.	Name of Chapter & Details	Hours Allotted
	Section 1	
1	**Indeterminate Forms**: La' hospital's rules for various indeterminate forms (Without proof).Various indeterminate forms like 0 0 form, ⍰ ⍰ form, 0.⍰ form, ⍰ □ ⍰ form, 0 0 form, 0 ⍰ form.	**6**
2	**Successive differentiation:** Successive differentiation, Calculation of nth derivative, Some standard results for nth derivatives of *ax e* , *amx* , sin(*ax* ⍰ *b*) , cos(*ax* ⍰ *b*) , *m* (*ax* ⍰ *b*) , 1 ( )⍰ *ax* ⍰ *b* , log(*ax* ⍰ *b*) , *e* sin(*bx c*) *ax* ⍰ , *e* cos(*bx c*) *ax* ⍰ . Leibnitz's Theorem and its examples.	**6**
3	**Mean value theorems**: Roll's theorem and problems related to it, Lagrange's mean value theorem and problems related to it, Cauchy's mean value theorem	**4**

	and problems related to it.	
	Taylor's theorem, expansions and indeterminate forms: Taylor's theorem (Without proof), Maclaurin's theorem (Without proof), Taylor's and Maclaurin's infinite series expansions, expansions of e^x, $\sin x$, $\cos x$, $(1+x)^n$, $\log(1+x)$ under proper conditions.	7
4	**Reduction Formulae:** Integration of $\sin^m x$ and $\cos^n x$: Reduction Formulae for $\int \sin^m x dx$, $\int \cos^n x dx$, Integration of $\sin^m x.\cos^n x$: Reduction Formulae for $\int \sin^m x \cdot \cos^n x dx$, $\int \tan^m x dx$ and $\int \cot^m x dx$ Where $m, n \in N; m, n \geq 2$ Reduction formulae for, $\int_0^{\frac{\pi}{2}} \sin^m x dx$, $\int_0^{\frac{\pi}{2}} \cos^n x dx$, $\int_0^{\frac{\pi}{2}} \sin^m x \cdot \cos^n x dx$ Where $m, n \in N; m, n \geq 2$	7
	Section 2	
5	**Polar, spherical & cylindrical co-ordinates**: Polar Co-ordinates in R2, distance between two points in polar Co-ordinates. Polar equations of a straight line, polar equations of circle. Relation between Cartesian and polar coordinates, Relation between Cartesian and spherical coordinates, Relation between Cartesian and cylindrical coordinates.	8
6	**Sphere:** General equation of sphere with center (α, β, γ) and radius a. Plane section of a sphere, intersection of two spheres, inertia of sphere and a line.	5
7	**Differential Equations of First Order and First Degree:** Definition and method of solving of **Linear differential equations** of first order and first degree , Definition and method of solving of **Bernoulli's** differential equation and Definition and methods of solving of **Exact** differential equation.	8

8	**Differential equations of first order and higher degree:** Differential equations of first order and first degree solvable for x, solvable for y, solvable for p. Clairaut's form of differential equation and Lagrange's form of differential equations.	7

Laboratory course

Practical No . (1) Draw the graph of $y = \sin x$ or $y = \cos x$ or $y = \tan x$

Practical No . (2) Draw the graph of $y = \sec x$ or $y = \operatorname{cosec} x$ or $y = \cot x$

Practical No . (3) Draw the graph of $y = \sin^{-1}x$ or $y = \cos^{-1}x$ or $y = \tan^{-1}x$.

Practical No . (4) Draw the graph of $y = \sec^{-1}x$ or $y = \operatorname{cosec}^{-1}x$ or $y = \cot^{-1}x$.

Practical No . (5) Draw the graph of parabola $y^2 = 4ax$ for $a < 0$ or $a > 0$

Practical No . (6) Draw the graph of ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$

or hyperbola $\frac{x^2}{a^2} - \frac{y^2}{b^2} = 1$

Practical No. (7) To solve given example of successive differentiation.

(a) Find the n^{th} derivative of $y = \frac{x}{x^2 + a^2}$

(b) Show that the n^{th} derivative of $y = \tan^{-1}x$ is

$$y_n = (-1)^{(n-1)}.(n-1)!\ [\sin\{n(\frac{\pi}{2} - y)\}\sin^n(\frac{\pi}{2} - y)]$$

(c) If $y = x \log\frac{x-1}{x+1}$ then prove that

$$y_n = (-1)^n.(n-2)!\ \{\frac{(x-n)}{(x-1)^n} - \frac{(x+n)}{(x+1)^n}\}$$

(d) If $y = \sin mx + \cos mx$ then show that

$$y_n = m^n \sqrt{1 + (-1)^n \sin 2mx}$$

Practical No. (8) To solve given example of Mean value Theorem.

(a) Using Lagrange's mean value theorem show that

$\frac{x}{1+x} < \log(1+x) < x$ for $x > 0$ and hence

$0 < \frac{1}{\log(1+x)} - \frac{1}{x} < 1$ for $x > 0$

(b) Using Lagrange's mean value theorem show that

$$x - \frac{x^3}{6} \leq \sin x \leq x \text{ for } x \geq 0$$

(c) $e^b - e^a = ce^c \log(b/a)$ where $0 < a < c < b$, $ab > 0$

(d) Using Cauchy's mean value theorem show that

$b^b - a^a = c^c\{b\log(b) - a\log(a)\}$ where $a < c < b$

Practical No. (9) To solve given example of reduction formula.

(a) $\int_0^{2a} x^2\sqrt{2ax - x^2}\,dx$ (b) $\int_0^{2a} x^{9/2}(2a-x)^{-1/2}\,dx$

(b) $\int_0^{\pi/4} \cos^3 2x . \sin^4 4x dx$ (d) $\int_0^{\infty} \frac{x^3}{(1+x^2)^{9/2}}\,dx$

Ans: (a) $\frac{5\pi}{8}a^4$ (b) $\frac{63\pi}{8}a^5$ (c) $\frac{128}{1155}$ (d) $\frac{2}{35}$

Practical No.(10) To solve given example of Bernoulli's Differential Equation.

(a) Solve : $\frac{dy}{dx} + y\tan x = y^3 \sec x$,

Ans. $Y = \frac{\cos x}{\sqrt{c - 2\sin x}}$

(b) Solve : $\frac{dy}{dx} + y\tan x = \frac{\cos x}{y}$,

Ans. $Y^2 \sec^2 x = 2\log(\sec x + \tan x) + c$

(c) Solve : $\frac{dy}{dx} + y\cos x = y^3 \sin 2x$,

Ans. $y^{-2} = (1+2\sin x) + c\, e^{2\sin x}$

Instructional Method and Pedagogy:

- Lectures will be conducted with the aid of multi-media projector, black board, OHP etc.
- Assignments based on course content will be given to the students at the end of each unit/topic and will be evaluated at regular interval.
- Surprise tests/Quizzes/Tutorials will be conducted.
- The course includes a laboratory, where students have an opportunity to build an appreciation for the concepts being taught in lectures.
- Approximately ten experiments shall be there in the laboratory related to course contents.

Students Learning Outcomes:

At the end of the course the students will be able to:

- Understand different coordinate system and relation between them.
- Understand how to solve differential equation and its application.
- Understand how to reduce calculation of limit by using different indeterminate form.
- Understand how to reduce calculation of integration by Reduction formula.

Reference Books:

- The Elements of Co-ordinate Geometry by S.L. Loney, Mac Millan & Co.
- Elementary Treatise on Co-ordinate geometry of three dimensions by R.J.T. Bell, Mac Millan & Co.
- A Text book of Analytical Geometry of three dimensions by P.K. Jain & Khalid Ahmad
- Differential Calculus by Shanti Narayan
- Differential Calculus by Gorakh Prasad
- Integral Calculus by Shanti Narayan
- Integral Calculus by Gorakh Prasad
- Differential Equations by D. A. Murray
- Three Dimension Geometry, Krishna Prakashan Mandir, Meerut.
- A Text book of Calculus, S. C. Arora and Ramesh Kumar, Pitamber Publishing Company Ltd. Delhi.