RayatShikshanSanstha’s

Sadguru Gadage Maharaj College, Karad

Syllabus for Bachelor of Science Part – I

1. TITLE: Mathematics

2. YEAR OF IMPLEMENTATION: 2019-20

3. PREAMBLE: The syllabus of Mathematics for B.Sc.-I gives sound knowledge with deep understanding of Mathematics to undergraduate students. Student learns Mathematics as one of the subject at B.Sc.-I. The goal of this syllabus is to make the study of Mathematics popular, interesting among the students for higher studies. The new syllabus is based on basic concepts and applications.

This syllabus is the outcome of the discussion and suggestions of subject experts and faculty members.

4. GENERAL OBJECTIVES OF THE COURSE:

1. Student learns basic concepts in Mathematics and also geometrical figures &graphical displays.

2. Student should be able to perform mathematical operations.

3. Develop mathematical curiosity and use inductive and deductive reasoning while solving problems.

4. Student should get adequate exposure to global and local concerns that explore them many aspects of Mathematical science.

5. DURATION: 1 Year

6. PATTERN: CBCS Semester System

7. MEDIUM OF INSTRUCTION: English

8. STRUCTURE OF COURSE: Theory & Practical

1) <u>FIRST SEMESTER ------- (NO. OF PAPERS 2 & Practical)</u>

		Theory				Practical	
Sr.No	Subject Title	Paper No & Paper Code	No. Of Lectures per Week	Credits		No. of Lectures per Week	Credits
1		Paper-I BMT101	5	4	Practical Paper-I: BMP103	4	2
		Paper-II BMT102					

<u>2) SECOND SEMESTER ------- (NO. OF PAPERS 2& Practical)</u>

		Theory				Practical	
Sr.No	Subject Title	Paper No & Paper Code	No. Of Lectures per Week	Credits		No. of Lectures per Week	Credits
1		Paper-III BMT201	5	4	Practical Paper-II: BMP203	4	2
		Paper-IV BMT202					

2) Structure and Titles of Papers of B.Sc. Course:

B.Sc. Part I Semester-I

Paper I : Differential Calculus-I

Paper II : Differential Equations-I

B. Sc. Part I Semester II

Paper III : Differential Calculus-II

Paper IV: Differential Equations-II

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Syllabus Introduced from June, 2019

B.Sc. Part I : Subject Title Mathematics

Semester –I

Theory: Paper I: Title of Paper: Differential Calculus-I

Learning Objectives:
1. The student learns $\epsilon - \delta$ definition of limit of a function of one variable.
2. The student learns important properties of continuous functions
3. The student learns differentiability of a function and geometrical meaning of derivative
4. The student learns to find the n^{th} derivative of product of two functions.

Unit-1 Limits and continuity of Real Valued functions (10)

1.1 $\epsilon - \delta$ definition of limit of function of one variable, left hand side limit and right hand side limit.

1.2 Properties of limits. (statements only)

1.3 Continuous functions :

1.3.1 Continuity at a point, continuous functions on interval.

1.3.2 Theorem: If f and g are continuous functions at point $x = a$, then $f + g$, $f - g$, fg and $\frac{f}{g}$ are continuous at point $x = a$. (without proof)

1.3.3 Theorem: Composite function of two continuous functions is continuous.

1.3.4 Examples on continuity.

1.4 Classification of discontinuities (first and second kind), removable discontinuity, jump discontinuity.

1.5 Bounded sets, least upper bound and greatest lower bound.

1.5.1 Least upper bound axiom and its consequences.

Unit-2 Properties of continuity of Real Valued functions (08)

2.1 Theorem: If a function f is continuous in the closed interval [a,b] then it is bounded in [a,b].

2.2 Theorem : If a function f is continuous in the closed interval [a,b], then it attains its bounds at least once in [a, b].

2.3 Theorem: : If a function f is continuous in the closed interval [a,b] and if $f(a)$ and $f(b)$ are of opposite signs then there exists $c \in (a, b)$ such that $f(c) = 0$.

2.4 Theorem: If a function f is continuous in the closed interval [a,b] and if $f(a) \neq f(b)$ then f assumes every value between $f(a)$ and $f(b)$.

Unit- 3 Differentiation (06)

3.1 Differentiability at a point, left hand derivative,right handderivative, differentiability in the interval $[a, b]$.

3.2 Examples on derivatives.

3.3 Geometrical interpretation of derivative.

3.4 Theorem: Continuity is necessary but not a sufficient condition for the existence of derivative.

3.5 Darboux's Theorem on derivatives.

Unit-4 Successive Differentiation **(**12)

4.1 Introduction.

4.2 n^{th} order derivative of some standard functions :

$(ax+b)^m$, e^{ax}, a^{mx}, $\frac{1}{ax+b}$, $\log(ax+b)$, $\sin(ax+b)$, $\cos(ax+b)$, $e^{ax}\sin(bx+c)$, $e^{ax}\cos(bx+c)$.

4.3 Examples.

4.3 Leibnitz's Theorem.

4.4 Examples on Leibnitz's Theorem.

Recommended Books:

1) G. B. Thomas and R. L. Finney, **Calculus and Analytical Geometry**, Pearson Education, 2007.

2) Shanti Narayan, **Differential Calculus**, S. Chand and Company, New Delhi. 2004.

3) G.V. Kumbhojkarand H.V. Kumbhojkar, Differential and Integral Calculus

4) H. Anton, I. Birens and Davis, **Calculus**, John Wiley and Sons, Inc.2002.

Reference Books:

1) Shanti Narayana and P. K. Mittal, **A Course of mathematical Analysis**, S. Chand andCompany, New Delhi. 2004.

2) S. C . Malik and SavitaArora, **Mathematical Analysis (Second Edition)**, New Age International Pvt. Ltd., New Delhi, Pune, Chennai.

3) Maity and Ghosh, **Differential Calculus**, New Central Book Agency (P) limited,Kolkata, India. 2007

Theory : Paper II: Title of Paper: Differential Equations

Learning Objectives:

1. The student learns exact differential equations and the condition for exactness.

2. The student learns differential equation of first order but not of first degree.

3. The student learns to find general solution of $f(D)y = 0$.

4. The student learns to find general solution of $f(D)y = X$

Unit 1: Differential Equations of First Order and First Degree (10)

1.1 Revision
1.2 Exact Differential equations.
  1.2.1 Definition and examples.
  1.2.2 Theorem: Necessary and sufficient condition for exactness.
  1.2.3 Working Rule for solving an exact differential equation.
1.2.4 Integrating factor with four rules.
1.2.4 Examples.
1.3 Linear Differential Equations.
1.3.1Definition and method of solution.
1.3.2 Examples.
1.4 Bernoulli's Equation :
  1.4.1 Definition and method of solution.
  1.4.2 Examples.
1.5 Orthogonal trajectories:
  1.5.1 Cartesian co-ordinates
  1.5.2 Polar co-ordinates.
  1.5.3 Examples.

Unit-2 Differential Equations of First Order but not of First Degree (08)

2.1 Introduction.
2.2 Equations solvable for p : Method and Examples.
2.3 Equations solvable for x : Method and Examples.
2.4 Equations solvable for y : Method and Examples.
2.5 Clairaut's Equation.
  2.5.1 Method of solution and Examples.
2.6 Equations reducible to Clairaut's form by substitutions and examples.

Unit-3 Linear Differential Equations with Constant Coefficients –I (09)

3.1 Introduction
3.1.1 Complementary function and particular integral.
3.1.2 Property: $(D-a)(D-b)y = (D-b)(D-a)y$
3.2 General Solution of f(D)y=0 .
  3.2.1 Solution of f(D)y=0 when A.E. has non-repeated real roots.
  3.2.2 Solution of f(D)y=0 when A.E. has repeated real roots.
  3.2.3 Solution of f(D)y=0 when A.E. has complex roots.
3.3 Examples.

Unit-4 Linear Differential Equations with constant Coefficients –II (09)

4.1 Meaning of symbol $\frac{1}{f(D)}$.

4.2 General solution of f(D) y=X.

4.3 Theorem: (i) $\frac{1}{D-a} X = e^{ax} \int X e^{-ax} dx$

(ii) $\frac{1}{D+a} X = e^{-ax} \int X e^{ax} dx$

4.4 General methods to find particular integral and examples.

4.5 Theorem : $\frac{1}{(D-a)^n} e^{ax} = \frac{x^n}{n!} e^{ax}; n \in \mathbb{Z}^+$.

4.6 Short methods of finding particular integral when X is in the form $e^{ax}, \sin ax, \cos ax, x^m (m\ being\ a\ positive\ integer), e^{ax}V, xV$ (V is function of x).

4.7 Examples.

Recommended Books:

1) H.V. Kumbhojkar, Dattar and Bapat, Calculus and Differential Equations, Nirali Prakashan.
2) Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
3) Diwan and Agashe, Differential Equations

Reference Books:

1) R. K. Ghosh and K. C, Maity, An Introduction to Differential Equations, Seventh Edition,2000; Book and Allied (P) Ltd
2) Sharma and Gupta, Differential Equation, Krishna Prakashan, Media co., Meerut.
3) D. A. Murray, Introductory course in Differential Equations, Khosala Publishing House,Delhi.
4) M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand Publications.

Practical – I

1. Continuity of function
2. Successive Differentiation: n^{th} order derivative
3. Leibnitz's theorem
4. Linear Differential Equations
5. Bernoulli's Equation
6. Orthogonal trajectories: Cartesian co-ordinates
7. Orthogonal trajectories: Polar co-ordinates
8. Clairaut's Equation and equations reducible to Clairaut's form
9. Linear Differential Equations with constant Coefficients-I (when $X = e^{ax}, \sin ax, \cos ax$)
10. Linear Differential Equations with constant Coefficients- II (when $X = x^m, e^{ax}V, xV$)

Books Recommended:

1) H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2) Shanti Narayan, Differential Calculus
3) H.V. Kumbhojkar, Dattar and Bapat, Calculus and Differential Equations, Nirali Prakashan.
4) Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
5) Diwan and Agashe, Differential Equations

Semester -II

Theory Paper III: Title of Paper: Differential Calculus-II

Learning Objectives:

1. The student learns exact differential equations and the mean value theorems.
2. The student learns series expansions and indeterminate forms.
3. The student learns Euler's theorem on homogeneous function.
4. The student learns the Lagrange's Method of undetermined multipliers method.

Unit 1: Mean Value Theorems (09)

3.1 Rolle's Theorem
- 3.1.1 Statement and proof.
- 3.1.2 Geometrical interpretation.
- 3.1.3 Examples.

3.2 Lagrange's Mean Value Theorem
- 3.2.1Statement and proof.
- 3.2.2 Geometrical interpretation.
- 3.2.3 Examples.

3.3 Cauchy's Mean Value Theorem
- 3.3.1Statement and proof.
- 3.3.2 Examples

Unit 2 : Series Expansion and Indeterminate Forms (08)

2.1Taylor's Theorem with Lagrange's and Cauchy's form of remainder (statements only)

2.2Maclaurin's Theorem with Lagrange's and Cauchy's form of remainder (statements only)

2.3 Maclaurin's Series for $e^x, \sin x, \cos x, \log(1+x), \log(1-x), (1+x)^n, \frac{1}{1+x}, \frac{1}{1-x}$.

2.4 Examples on Taylor's series and Maclaurin's series.

2.5 Indeterminate Forms : L'Hospital rule ((statement only).

The Forms : $\frac{0}{0}, \frac{\infty}{\infty}, 0\times\infty, \infty-\infty, 0^0, \infty^0, 1^\infty$ and examples

Unit-3 Partial Differentiation (10)

3.1Introduction: Functions of two variables, limit and continuity of functions of two variables.

3.2 Partial derivative, partial derivative of higher orders, Chain Rule (statement only) and its examples.

3.3 Homogeneous functions: Definition with illustrations.

3.4 Euler's theorem on homogenous functions.

3.4.1 If z is a homogenous function of degree n in x ,y and $z=f(u)$, then $x\frac{\partial f}{\partial x}+y\frac{\partial f}{\partial y}=n\frac{f(u)}{f'(u)}$.

3.4.2 If z is a function of degree n in x and y and $z=f(u)$ then

$$x^2\frac{\partial^2 u}{\partial x^2}+2xy\frac{\partial^2 u}{\partial x\partial y}+y^2\frac{\partial^2 u}{\partial y^2}=g(u)(g'(u)-1) \text{ where } g(u)=n\frac{f(u)}{f'(u)}$$

3.4.3 If $z=$ f(x, y) is a homogenous function of degree n,then

$$x^2\frac{\partial^2 z}{\partial x^2}+2xy\frac{\partial^2 z}{\partial x\,\partial y}+y^2\frac{\partial^2 z}{\partial y^2}=n(n-1)z.$$

Unit 4-Extreme Values (09)

4.1 Maxima and Minima for function of two variables:
Maximum, Minimum and Stationary values of function of two variables.

4.2 Conditions for maxima and minima (statement only) and examples.

4.3 Lagrange's Method of undetermined multipliers of two variables and examples.

Recommended Books:

1) G.B. Thomas and R.L. Finney, Calculus, Pearson Education, 2007

2) Differential Calculus by Shanti Narayan
3) G.V. Kumbhojkar and H.V. Kumbhojkar, Differential and Integral Calculus

Reference Books:

1) Shanti Narayana and P. K. Mittal, **A Course of mathematical Analysis**, S.Chand andCompany, New Delhi. 2004.
2) S. C .Malik and Savitaarora, **Mathematical Analysis (second Edition)**, New AgeInternational Pvt. Ltd., New Delhi, Pune, Chennai.
3) Maity and Ghosh, **Differential Calculus**, New Central Book Agency (P) limited,Kolkata, India. 2007

Theory : Paper IV: Title of Paper: Differential Equations-II

Learning Objectives:

1. The student learns homogeneous linear differential equation and method of solution.
2. The student learns second order differential equations.
3. The student learns the ordinary simultaneous differential equations.
3. The student learns the condition for integrability of Pdx+Qdy+Rdz=0.

Unit 1: Homogeneous Linear Differential Equations (08)

1.1 General Form of Homogeneous Linear Differential Equation.
1.2 Method of solution and examples
1.3 Equations reducible to Homogeneous Linear Form.
1.4 Examples.

Unit-2 Second Order Linear Differential Equations (14 **)**

2.1 General Form.
2.2 Complete solution when one integral is known: method and examples.
2.3 Transformation of the equation by changing the dependent variable and examples (removal of first order derivative)
2.4 Transformation of the equation by changing the independent variable and examples.
2.5 Method of variation of parameters and examples

Unit-3 Ordinary Simultaneous Differential Equations (06)

3.1 Simultaneous linear differential equations of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.
3.2 Method of solving simultaneous linear differential equation.
3.3 Geometrical interpretation.
3.4 Examples

Unit-4 Total Differential Equations (08)

4.1Total differential equation $Pdx + Qdy + Rdz = 0$.
4.2 Necessary condition for integrability of total differential equation.
4.3 Method of solving total differential equation.
a) Method of inspection
b) One variable regarding as constant
4.4 Geometrical interpretation
4.5 Geometrical relation between total differential equation and simultaneous linear differential equation.
4.6 Examples

Recommended Books:

1) Sharma and Gupta, Differential Equation, Krishna Prakashan, Media co., Meerut.

2) D.A. Murray, Introductory course on Differential Equations, Orient Longman,(India),1967.
3) M.D. Raisinghania, Ordinary and Partial Differential Equations, S.Chand Pub.

Reference Books:

1) R. K. Ghosh and K. C, Maity, An Introduction to Differential Equations, Seventh Edition,2000; Book and Allied (P) Ltd
2) Diwan and Agashe, Differential Equations
3) D. A. Murray, Introductory course in Differential Equations, Khosala Publishing House,Delhi.

Practical-II

1. Lagrange's Mean Value Theorem
2. Cauchy's Mean Value Theorem
3. Indeterminate forms
4. Extreme values
5. Lagrange's undetermined multiplier method
6. Homogeneous Linear Differential Equations and Reducible to Homogeneous Linear Differential Equations
7. Second Order Linear Differential Equations(One solution is known)
8. Second Order Linear Differential Equations(By Changing Dependent Variable)
9. Second Order Linear Differential Equations(By Changing Independent Variable)
10. Total Differential Equations

Books Recommended:

1) H. Anton, I. Birens and S. Davis, Calculus, John Wiley and Sons, Inc., 2002.
2) Shanti Narayan, Differential Calculus
3) H.V. Kumbhojkar, Dattar and Bapat, Calculus and Differential Equations, NiraliPrakashan.
4) Shepley L. Ross, Differential Equations, 3rd Ed., John Wiley and Sons, 1984.
5) Diwan and Agashe, Differential Equations