

**Swami Ramanand Teerth
Marathwada University,
Nanded.**

**B.A./B.Sc. Second Year
Syllabus (Mathematics)**

Effective from June -2009

B.A./B.Sc. S.Y. (Mathematics)
Theory Paper-IV- Advanced Calculus

No. of Periods 120

Max. Marks: 100

- Unit I** : Definition of a Sequence, Theorems on Limits of Sequences, Bounded and Monotonic Sequences, Non convergent sequences, Cauchy's general principle of convergence. Series of nonnegative terms, Comparison tests, D'Alembert's ratio test, Raabe's Test, Logarithmic test, Alternating Series, Leibnitz's test, Absolute and Conditional Convergence.
- Unit II** : Continuity, Sequential Continuity, Properties of Continuous Functions, Uniform Continuity.
- Unit III** : Differentiation of Function of single variable, Darboux's theorem, Rolle's theorem and it's interpretation, Lagrange's mean value theorem and it's geometrical interpretation, Cauchy's mean value theorem and it's geometrical interpretation, Taylor's theorem for function of single variable with various forms of remainders.
- Unit IV** : Line integral, plane curve definitions, properties of line integral, Double integral, Integral over a rectangle, Partition of rectangle, integral as limit of sum, prosperities, change of variables.
Beta, Gamma Functions and their properties.
- Text Book** : 1. Mathematical Analysis, By- S.C. Malik, Savita Arora.
(Second reprint 2002), New age international.
- Scope** Chapter 3: 1,1.1,2,2.1,2.2,2.3,2.4,3,3.1, 3.3,4,4.1,5,6,7,7.1,8,10,10.1
Chapter 4: 1,1.1,1.2,1.3,1.4,2.1,2.2,3,3.1,3.2,3.3,5,6,7,10,10.1,10.2.
Chapter 5: 1,1.1,1.2,1.3,2,2.1,2.2,2.3,2.4,3,3.1,3.2,3.3,3.4,3.5,4,4.1
Chapter 6: 1,1.1,1.2,2.1,2.2,3,3.1,3.2,4,5,5.1,6,6.1,6.2,7,8,8.1.
Chapter 17: 1,1.1,1.2,1.4,2,2.2,2.4,2.6,2.5, Appendix-I Page No. 872 to 878.
- Reference Books** : 1. Text Book on Integral Calculus-By: Gorakh Prasad. 14th edition 2000,
Pothishala Pvt. Ltd. Allahabad.

B.A./B.Sc. S.Y. (Mathematics)

Theory Paper-V

DIFFERENTIAL EQUATIONS

No. of Periods 120

Max. Marks: 100

- Unit I** : **Series solutions of differential equations:**
Special Functions, power Series Solution, Validity of Power Series. Bessel's equation solution, Bessel's function, Recurrence formulae, Orthogonality of functions, Generating function. Legendre's equation, Legendre's polynomial, Legendre's function of second kind. General solution of Legendre's equation, Rodrigus's formula, Generating function of Legendre's polynomial, Orthogonality, Recurrence formulae, Orthogonality of Eigen function.
- Unit II** : **Laplace Transformations**
Laplace transformation: Formulae, Properties. Laplace transformation of the derivative of $f(t)$. Laplace transformation of derivative of order n . Laplace transform of integrals of $f(t)$, transform of $t.f(t)$, $1/t f(t)$. Unit step function. Shifting theorem, Convolution theorem. Evaluation of integrals. Inverse Laplace transform: Formulae, Multiplication by s , division by s , shifting properties. Inverse Laplace transform of derivatives and integrals, partial fraction method. Solution of differential equations and solution of simultaneous differential equations.
- Unit III** : **Partial differential equation of the first order:**
Definition, Derivation by elimination of constant, derivation by elimination of arbitrary function.
Integrals of the non-linear equation: Complete and particular integral, singular integral, general integral. Intergral of linear equation, Equation equivalent to linear equation, Lagrange's solution, Verification of Lagrange's solution, Linear Equation involving more than two independent variables.
Geometrical meaning of linear partial differential equation. Special methods of solution: Standard I,II,III,IV, general method of solution
- Unit IV** : **Partial Differential equation of second order:**
General method of solving, General linear partial differential equation of an order higher than the first.
Homogeneous equations with constant coefficients: Complementary functions, Complementary function for repeated, imaginary roots. The particular integral.
Non-homogeneous equations with constant coefficient:
The complementary function. The particular integral.
Transformation of equation.
Calculus of variations: Functionals, Definition Euler's equation, Extremal, Isopermetric problems.

- Text Book** : 1. Advanced Engineering Mathematics By: H.K. Dass, 9th Revised Edition 2001 (S. Chand and Co.)
- Scope** : Chapter 8: 8.1, to 8.4, 8.6 to 8.9, 8.11, 8.12, 8.17.1, 8.18 to 8.25, 8.29 to 8.30.
Chapter 13: 13.1 to 13.12, 13.15, 13.17 to 13.28, 13.30, 13.31
Chapter 17: 17.1 to 17.7,
- Scope** : 2. Introductory course in differential equations. By: D.A. Murray.
Art.-107 to 133
- References** : 1. Advanced Engineering Mathematics-Ervin Kreyszig. Johan Wiley and sons Inc. New York.
2. Calculus of Variations with Applications-A.S. Gupta Prentice Hall of India.
3. Operational Mathematics-R.V. Churchill.
4. Elements of Partial differential equations-I.N. Sneddon. McGraw-Hill Book Company.
5. Differential equations-Jane Cronin. (Publisher-Marcel Dekkar, Co.1994.)
6. Theory and Problems of Differential equations.-Richard Bronson. McGraw-Hill, inc.1973.

B.Sc. S.Y. (Mathematics)

Theory Paper-VI

MACHANICS

No. of Periods 120

(Only for B.Sc. Students)

Max. Marks: 100

- Unit I** : (Statics)
Forces acting on a rigid body: Introduction, Moment of a force, couples, Equivalent Couples, conditions of equilibrium of forces acting on rigid body, Equilibrium of forces that are coplanar and acting on a rigid body. Centroid of weighted points, centre of inertia, centre of gravity, C.G. of uniform bodies, (Uniform rod, triangular lamina, Uniform parallelogram)
- Unit II** : (Dynamics)
Kinematics and Dynamics of a particle (Two Dimension) Introduction, Definition of velocity, acceleration, curvature and principle normal, Tangential and normal components of velocity and acceleration, Angular speed, angular velocity, angular acceleration, components of velocity and accelerations along radial and transverse directions. Areal speed, Areal velocity.
- Unit III** : Kinetics of a particle:
Introduction, Newton's Laws of motion and deductions. Linear momentum, angular momentum, Impulsive force and its impulse, conservation of linear momentum, Impact of two bodies, work, work done by a variable force, power, Energy, Scalar point function, vector point function, Field of force, conservative field of force, Potential function.
- Unit IV** : Projectile motion and central orbits.
Rectilinear motion, Motion under gravity, Projectile, its motion and equation of trajectory, Parabola of safety. Definition of central orbit, properties, Differential equations of central orbit, Apses, Finding law of force in different cases. Kepler's Laws of planetary motion and deductions.
- Text Book** : Mechanics and Differential Geometry-V. Tulsani, Wanrhekar, N.N. Saste. Pub., S. Chand and Company (Pvt.) Ltd. Ram Nagar, New Delhi, (Edn. 1987).
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- Scope** : (Statics) Chapter 3: Art. 3.1 to 3.11, Chapter 4: Art. 4.1 to 4.6
Dynamics (Unit-II,III,IV): Chapter 1: Art 1.01 to 1.14, Chapter 2 : Art. 2.01 to 2.25, Chapter 3 : Art. 3.01 to 3.15, Chapter 4: Art. 4.01 to 4.08 and 4.18.
- References** :
1. Mechanics (R.P. Unified) –B.R. Thakur and G.P Shrivastav, Pub. Ramprasad and son's.
2. Mechanics, By- Shanti Narayan, S. Chand and Co.

B.Sc. Second Year

Practical-Paper No. –VII. (Only for B.Sc. Students)

Note:

1. For a batch of 20 students, two periods per week, will be the work load.
 2. A record book, consisting of at least 50% of the practical given below given below be maintained by each student.
 3. The theory part required for the practical be explained to the students, by the teacher concerned, from the reference books.
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PARCTICALS:

1. Show that the sequence $\left(1 + \frac{1}{n}\right)^n$ is convergent and its limit lies between 2 and 3.

2. Test the convergence of the series

$$\frac{\alpha}{\beta} + \frac{1+\alpha}{1+\beta} + \frac{(1+\alpha)(2+\alpha)}{(1+\beta)(2+\beta)} + \dots$$

3. Find the limits given below

i) $\lim_{x \rightarrow 0} \frac{(1+x)^{\frac{1}{x}} - e}{x}$

ii) $\lim_{x \rightarrow 0} \left(\frac{1}{x^2} - \frac{1}{\sin^2 x} \right)$

iii) $\lim_{x \rightarrow 0} \frac{(\tan x)^{\frac{1}{x}}}{x}$

iv) $\lim_{x \rightarrow 0} \left(\frac{e^x - 2 \cos x + e^{-x}}{x \cdot \sin x} \right)$

4. Prove that $J_{-n}(x) = (-1)^n J_n(x)$ where n is positive integer.

5. Show that i) $P_{2n}(0) = (-1)^n \frac{1.3.5 \dots (2n-1)}{2.4.6 \dots 2n}$

ii) $P_{2n+1}(0) = 0$

6. Evaluate $\int_0^{\infty} t \cdot e^{-3t} \sin t \, dt$

7. Find the inverse Laplace transform of $\frac{s+4}{s(s-1)(s^2+4)}$

8. Evaluate $\iint y \, dx \, dy$ over the part of the plane bounded by the lines $y = x$ and the parabola $y = 4x - x^2$
9. Trace the curve “witch of Agnesi” : $xy^2 = 4a^2(2a - x)$.
10. Trace the curve Cissoid : $y^2(2a - x) = x^3$.
11. Trace the Cycloid : $x = a(\theta + \sin \theta)$, $y = a(1 - \cos \theta)$
12. Trace the Parabola: $x = at^2$, $y = 2at$.
13. Trace the curve $r = a \sin 2\theta$
14. Trace the curve $r^2 = a \sin 2\theta$
15. Trace the Cardioid $r = a(1 + \cos \theta)$
16. Evaluate $\iint_R [x + y] \, dx \, dy$, over the rectangle $R = [0, 1; 0, 2]$.
17. Trace the curve $x = a \cos^3 \theta$, $y = a \sin^3 \theta$, and find total length of the curve.
18. Trace the cardioid $r = a(1 - \cos \theta)$ and find its perimeter.
19. Trace the cycloid, $x = a(\theta - \cos \theta)$, and find the area included.
20. Find the area common to the two Parabolas $y^2 = 4x$ and $x^2 = 4y$.
21. Find the area of the loop of the curve $ay^2 = x^2(a - x)$
22. Find the area of one loop of the curve $r = a \cos 4\theta$.
23. A function f is defined on the rectangle $R = [0, 1; 0, 1]$ as follows:

$$f(x, y) = \begin{cases} \frac{1}{2}, & \text{when } y \text{ is rational} \\ x, & \text{When } y \text{ is irrational} \end{cases}$$

Show that the double integral $\iint_R f(x, y) \, dx \, dy$ does not exist.
24. The area bounded by the parabola $y^2 = 4x$ and the line $y = 2x$ is revolved about x -axis; find the volume and the area of the surface so generated.
25. Find $\iint_R (x + 2y) \, dx \, dy$, when $R = [1, 2; 3, 5]$
26. Find the area of the surface formed by the revolution of $x^2 + 2y^2 = 16$ about its major axis.
27. Find the volume of the spindle shaped solid generated by revolving the asteroid about the x -axis,
28. Find the volume of the solid generated by revolving the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ about y -axis.

29. Find the surface area generated by revolving the circle $x = a \cos\theta$, $y = a \sin\theta$ about x-axis

30. if n is a positive integer, prove that the ratio of the areas enclosed by the curves $x^{2n} + y^2 = 1$, $x^{2n} + y^{2n} = 1$ is $n2^{1/n}/(n+1)$.

Pattern of the theory Question Paper
B.Sc. (Second Year) Mathematics (Yearly Pattern)

Maximum Marks: 100

Duration: 3:00 Hrs.

N.B.:-

- i) All questions are compulsory.
 - ii) Figures to the right indicate full marks.
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Q. 1 Ten Multiple choice Questions based on all units of 2 marks each Marks (20)

Q. 2 A) Attempt any one of the following

- a) Theory Marks (10)
- b) Theory Marks (10)

B) Attempt any one of the following

- a) Theory Marks (05)
- b) Problem Marks (05)
- c) Problem Marks (05)

Q. 3 A) Attempt any one of the following

- a) Theory Marks (10)
- b) Theory Marks (10)

B) Attempt any one of the following

- a) Theory Marks (05)
- b) Problem Marks (05)
- c) Problem Marks (05)

Q. 4 A) Attempt any one of the following

- a) Theory Marks (10)
- b) Theory Marks (10)

B) Attempt any one of the following

- a) Theory Marks (05)
- b) Problem Marks (05)
- c) Problem Marks (05)

Q. 5 A) Attempt any one of the following

a) Theory

Marks (10)

b) Theory

Marks (10)

B) Attempt any one of the following

a) Theory

Marks (05)

b) Problem

Marks (05)

c) Problem

Marks (05)
