

| Department of Mathematics |             |             |                      | Class: I B.Sc. Physics/Statistics |                     |     |     |       |
|---------------------------|-------------|-------------|----------------------|-----------------------------------|---------------------|-----|-----|-------|
| Semester                  | Course Type | Course Code | Course Title         | Credits                           | Contact Hours/ week | CIA | Ext | Total |
| I                         | Allied      | 20U1MAC1    | Allied Mathematics-I | 5                                 | 6                   | 25  | 75  | 100   |

### Course Objectives

On completion of this course, the learner will

1. Be able to understand higher order differentiation and to know application of differential calculus.
2. Know the properties of definite integrals and methods of integration of higher powers of trigonometric functions.
3. Know the physical applications of derivatives of vectors especially the divergence and curl.
4. Have thorough knowledge of solving definite integrals and obtain a numerical solution.

### Unit-I: (14 hrs)

Application of DeMoivre's Theorem : Expression for  $\sin n\theta$ ,  $\cos n\theta$  and  $\tan n\theta$  – Expression for  $\sin^n \theta$ ,  $\cos^n \theta$  and  $\sin^m \theta \cos^n \theta$  – Problems.

### Unit-II: (22 hrs)

Differentiability – Chain rule – Differentiation of Inverse trigonometric functions – Differentiation by transformation – Differentiation of logarithmic functions – Differentiation of implicit functions – Higher derivatives –  $n^{\text{th}}$  derivatives of some standard functions – Leibnitz's rule – Problems.

### Unit-III: (18 hrs)

Integration by parts – Reduction formula for  $\int \sin^n x \, dx$ ,  $\int \cos^n x \, dx$  and  $\int \sin^m x \cos^n x \, dx$  (Problems only) – Evaluation of double and triple integrals.

### Unit-IV: (18 hrs)

Vector differentiation – Vector differential operator – Gradient, Divergence and Curl and their simple properties – Directional Derivative and its maximum value – Solenoidal and Irrotational vectors (simple problems only) – Vector integration (Line Integrals only).

### Unit-V: (18 hrs)

Numerical Integration – Trapezoidal rule – Simpson's 1/3 and 3/8 rules – Romberg's Method – Weddle's rule – Problems.

### Text book

1. Allied Mathematics, Dr. S. Arumugam & Isaac. Vol I, New Gamma Publishing House, Palayamkottai. (2014) (For Unit I, III) (Part – III Chapter: 1(1.1, 1.2); Part – II Chapter 3(3.4-3.6))
2. Calculus, Dr. S. Arumugam & Isaac, New Gamma Publishing House, Palayamkottai. (2008) (For Unit II) (Chapter: 2(2.4 – 2.7, 2.10 – 2.12))
3. Allied Mathematics, Dr. S. Arumugam & Isaac. Vol II, New Gamma Publishing House, Palayamkottai. (2011) (For Unit IV) (Chapter: 1, 2)

- Numerical Methods, P. Kandasamy, K. Thilagavathy, K. Gunavathi, S. Chand Publishers, 2008.

(For Unit V) (Chapter: 9(9.7 –9.15))

### Books for Reference

- Ancillary Mathematics, T.K Manikavasagampillai & Others Viswanathan printers and publishers Pvt. Ltd., Chennai.
- Allied Mathematics, Volume II, P. Kandasamy, K. Thilagavathy, S. Chand & Company Pvt. Ltd.

### Web Resources

- <https://brilliant.org/wiki/expansions-of-certain-trigonometric-functions/#expanding-sintheta-costheta-tantheta-in-terms-of-theta-for-small-theta>
- <https://www.math24.net/leibniz-formula/>
- [https://www.whitman.edu/mathematics/calculus\\_online/section08.02.html](https://www.whitman.edu/mathematics/calculus_online/section08.02.html)
- <http://tutorial.math.lamar.edu/Classes/CalcIII/LineIntegralsVectorFields.aspx>
- [http://mathforcollege.com/nm/mws/gen/07\\_int/mws\\_gen\\_int\\_txt\\_gaussquadrature.pdf](http://mathforcollege.com/nm/mws/gen/07_int/mws_gen_int_txt_gaussquadrature.pdf)

### Course Learning Outcomes

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

| Number | Course Learning Outcome   | Knowledge level |
|--------|---|-----------------|
| CLO 1  | Apply DeMoivre's theorem to solve problems on powers of trigonometric functions.  | Upto K2         |
| CLO 2  | Use the concept of differentiation to find derivatives of inverse trigonometric functions, implicit function and logarithmic functions.   | Upto K3         |
| CLO 3  | Evaluate integrals using integration by parts and apply integration to compute double and triple integrals.   | Upto K4         |
| CLO 4  | Use vector differentiation to evaluate gradient, divergence and curl of a vector point function and related identities and to evaluate line integrals using vector integration. | Upto K3         |
| CLO 5  | Use the concept of integration to solve numerical problems.   | Upto K3         |

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

### Mapping with Courses Learning Outcomes (CLOs)

| CLO/<br>PO-<br>PSO | PO  |     |     |     |     | PSO  |      |      |      |      |      |      |
|--------------------|-----|-----|-----|-----|-----|------|------|------|------|------|------|------|
|                    | PO1 | PO2 | PO3 | PO4 | PO5 | PSO1 | PSO2 | PSO3 | PSO4 | PSO5 | PSO6 | PSO7 |
| CLO 1              | 3   | 2   | -   | -   | 1   | 2    | 2    | 2    | 3    | 3    | -    | -    |
| CLO 2              | 3   | 2   | -   | -   | 1   | 2    | 1    | 2    | 3    | 3    | -    | -    |
| CLO 3              | 3   | 2   | -   | -   | 1   | 2    | 1    | 2    | 3    | 3    | -    | -    |
| CLO 4              | 3   | 2   | -   | -   | 1   | 2    | 1    | 2    | 3    | 3    | -    | -    |
| CLO 5              | 3   | 2   | -   | -   | 1   | 2    | 1    | 2    | 3    | 3    | -    | -    |

3 – Advance Application

2 - Intermediate Level

1- Basic Level

#### Pedagogy

Lecture, Seminar, Quiz, Problem Solving, Tutorial, Group Discussion and Power point presentation.

#### BLUE PRINT – External Exam

| S. No.                  | CLOs | K Level  | Section A           |            | Section B           |            | Section C<br>(Either/or<br>Choice) | Section D<br>(Open<br>Choice) |
|-------------------------|------|----------|---------------------|------------|---------------------|------------|------------------------------------|-------------------------------|
|                         |      |          | MCQs                |            | Short Answers       |            |                                    |                               |
|                         |      |          | No. of<br>questions | K<br>Level | No. of<br>questions | K<br>level |                                    |                               |
| 1                       | CLO  | Up to K2 | 2                   | K1 &       | 1                   | K1         | 2(K2 & K2)                         | 1(K2)                         |
| 2                       | CLO  | Up to K3 | 2                   | K1 &       | 1                   | K2         | 2(K2 & K2)                         | 1(K3)                         |
| 3                       | CLO  | Up to K4 | 2                   | K1 &       | 1                   | K2         | 2(K4 & K4)                         | 1(K4)                         |
| 4                       | CLO  | Up to K3 | 2                   | K1 &       | 1                   | K1         | 2(K3 & K3)                         | 1(K3)                         |
| 5                       | CLO  | Up to K3 | 2                   | K1 &       | 1                   | K2         | 2(K3 & K3)                         | 1(K3)                         |
| No. of Questions to be  |      |          | 10                  |            | 5                   |            | 10                                 | 5                             |
| No. of Questions to be  |      |          | 10                  |            | 5                   |            | 5                                  | 3                             |
| Marks for each question |      |          | 1                   |            | 2                   |            | 5                                  | 10                            |
| Total Marks for each    |      |          | 10                  |            | 10                  |            | 25                                 | 30                            |

K1 - Remembering and recalling facts with specific answers

K2 - Basic understanding of facts and stating main ideas with general answers

K3 - Application oriented - Solving Problems

K4 - Examining, analyzing, presentation and make inferences with evidences

## Lesson Plan

| Unit               | Description   | Hours | Mode                    |
|--------------------|---|-------|-------------------------|
| I                  | Application of DeMoivre's Theorem:<br>Expression for $\sin n\theta$ , $\cos n\theta$ and $\tan n\theta$       | 7     | 14<br>Lecture, Quiz     |
|                    | Expression for $\sin^n \theta$ , $\cos^n \theta$ and $\sin^m \theta \cos^n \theta$                            | 7     |                         |
| II                 | Differentiability – Chain rule  | 2     | 22<br>Lecture, Quiz     |
|                    | Differentiation of Inverse trigonometric functions  | 3     |                         |
|                    | Differentiation by transformation   | 3     |                         |
|                    | Differentiation of logarithmic functions – Differentiation of implicit functions                              | 4     |                         |
|                    | Higher derivatives – nth derivatives of some standard functions – Leibnitz's rule                             | 10    |                         |
| III                | Integration by parts  | 4     | 18<br>PPT, Lecture      |
|                    | Reduction formula for $\int \sin^n x dx$ , $\int \cos^n x dx$ and $\int \sin^m x \cos^n x dx$ (Problems only) | 6     |                         |
|                    | Evaluation of double integrals  | 4     |                         |
|                    | Evaluation of triple integrals  | 4     |                         |
| IV                 | Vector differentiation – Vector differential operator   | 3     | 18<br>Lecture, Tutorial |
|                    | Gradient, Divergence and Curl and their simple properties   | 4     |                         |
|                    | Directional Derivative and its maximum value  | 4     |                         |
|                    | Solenoidal and Irrotational vectors (simple problems only)  | 3     |                         |
|                    | Vector integration (Line Integrals only).   | 4     |                         |
| V                  | Numerical Integration   | 2     | 18<br>PPT, Lecture      |
|                    | Trapezoidal rule  | 3     |                         |
|                    | Simpson's 1/3 and 3/8 rules   | 5     |                         |
|                    | Romberg's Method  | 4     |                         |
|                    | Weddle's rule   | 4     |                         |
| <b>Total Hours</b> |   |       | <b>90</b>               |

### Course Designers

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2. Mr. P. NATARAJ, Assistant Professor, Department of Mathematics.