KANNUR UNIVERSITY

COURSE STRUCTURE AND SYLLABUS

For

UNDERGRADUATE PROGRAMME

In

MATHEMATICS

CORE, COMPLEMENTARY
And
OPEN COURSES

Under

CHOICE BASED CREDIT AND SEMESTER SYSTEM

w. e. f. 2014 ADMISSION

KANNUR UNIVERSITY- 2014 ADMISSION

COURSE STRUCTURE UG PROGRAMME – MATHEMATICS

CREDIT DISTRIBUTION

	Common Courses		Core Course	Complementary Courses			
Semester	**English**	**Additional Language**	**Mathematics**	**Statistics**	**Complem-entary course 2**	**Open Course**	**Total**
I	4+3	4	4	3	3	--	21
II	4+3	4	4	3	3	--	21
III	4	4	4	3	3	--	18
IV	4	4	4	3	3	--	18
V	--	--	4+4+4+4+3	--	--	2	21
VI	--	--	4+4+4+4+3+2	--	--	--	21
Total	**22**	**16**	**56**	**12**	**12**	**2**	**120**

MARK DISTRIBUTION

	Common Courses		Core Course	Complementary Courses			
Semester	**English**	**Additional Language**	**Mathematics**	**Statistics**	**Complem-entary course 2**	**Open Course**	**Total**
I	2X50=100	50	60	50	50	--	310
II	2X50=100	50	60	50	50	--	310
III	50	50	60	50	50	--	260
IV	50	50	60	50	50	--	260
V	--	--	5X60=300	--	--	25	325
VI	--	--	5X60+35=335 (Core +Project)	--	--	--	335
Total	**300**	**200**	**875**	**200**	**200**	**25**	**1800**

SEMESTERWISE PROGRAMME DETAILS

SEMESTER I

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Common Course (English)	5	4	3
2	Common Course (English)	4	3	3
3	Common Course (Additional Language)	4	4	3
4	Core Course I	4	4	3
5	Complementary 1 (Course I)	4	3	3
6	Complementary 2 (Course I)	4	3	3

SEMESTER II

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Common Course (English)	5	4	3
2	Common Course (English)	4	3	3
3	Common Course (Additional Language)	4	4	3
4	Core Course 2	4	4	3
5	Complementary 1 (Course II)	4	3	3
6	Complementary 2 (Course II)	4	3	3

SEMESTER III

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Common Course (English)	5	4	3
2	Common Course (Additional Language)	5	4	3
3	Core Course 3	5	4	3
4	Complementary 1 (Course III)	5	3	3
5	Complementary 2 (Course III)	5	3	3

SEMESTER IV

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Common Course (English)	5	4	3
2	Common Course (Additional Language)	5	4	3
3	Core Course 4	5	4	3
4	Complementary 1 (Course IV)	5	3	3
5	Complementary 2 (Course IV)	5	3	3

SEMESTER V

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Core Course 5	5	4	3
2	Core Course 6	5	4	3
3	Core Course 7	5	4	3
4	Core Course 8	4	4	3
5	Core Course 9	4	3	3
6	Open Course	2	2	2

SEMESTER VI

Sl.No	Title of the Course	Contact hours/week	Credits	Exam hrs
1	Core Course 10	5	4	3
2	Core Course 11	5	4	3
3	Core Course 12	5	4	3
4	Core Course 13	5	4	3
5	Core Course 14 (Elective)	5	3	3
6	Project	---	2	---

Scheme of B.Sc. Mathematics (Core)

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1B01 MAT**	Differential Calculus	72	4	3	72	48	12	60
II	**2B02 MAT**	Integral Calculus	72	4	3	72	48	12	60
III	**3B03 MAT**	Elements of Mathematics I	90	4	3	72	48	12	60
IV	**4B04 MAT**	Elements of Mathematics II	90	4	3	72	48	12	60
V	**5B05 MAT**	Real Analysis	90	4	3	72	48	12	60
	5B06 MAT	Abstract Algebra	90	4	3	72	48	12	60
	5B07 MAT	Differential Equations, Laplace Transform and Fourier Series	90	4	3	72	48	12	60
	5B08 MAT	Vector Calculus	72	4	3	72	48	12	60
	5B09 MAT	Graph Theory	72	3	3	72	48	12	60
	5D--- ------	**Open Course**	36	2	2	30	20	5	25
VI	**6B10 MAT**	Linear Algebra	90	4	3	72	48	12	60
	6B11 MAT	Numerical Methods and Partial Differential Equations	90	4	3	72	48	12	60
	6B12 MAT	Complex Analysis	90	4	3	72	48	12	60
	6B13 MAT	Mathematical Analysis and Topology	90	4	3	72	48	12	60
		Elective	90	3	3	72	48	12	60
	6B14A MAT	Operations Research							
	6B14B MAT	Mathematical Economics							
	6B14C MAT	Classical Mechanics							
	6B14D MAT	Programming in Python – Theory	60		2	46	30		
		Programming in Python – Practical	30		2	26	18		
	6B15 MAT	**Project**	---	2	---	---	28	7	35
Total **(Core + Project + Open course)**			---	**54+2+2 = 58**	---	-----	**672+ 28+20 =720**	**168+ 7+5 =180**	**840+ 35+25 =900**

Scheme of Open Courses- Mathematics

Mathematics Departments can offer one of the following Open Courses to the students other than B.Sc. Mathematics

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
IV	**5D01 MAT**	Business Mathematics	36	2	2	30	20	5	25
	5D02 MAT	Astronomy							
	5D03 MAT	Quantitative Arithmetic and Reasoning							
	5D04 MAT	Linear Programming							

Scheme of Complementary Course- Mathematics for Physics

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 MAT-PH**	Mathematics for Physics I	72	3	3	60	40	10	50
II	**2C02 MAT-PH**	Mathematics for Physics II	72	3	3	60	40	10	50
III	**3C03 MAT-PH**	Mathematics for Physics III	90	3	3	60	40	10	50
IV	**4C04 MAT-PH**	Mathematics for Physics IV	90	3	3	60	40	10	50
Total			**---**	**12**	**----**	**240**	**160**	**40**	**200**

Scheme of Complementary Course- Mathematics for Chemistry

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 MAT-CH**	Mathematics for Chemistry I	72	3	3	60	40	10	50
II	**2C02 MAT-CH**	Mathematics for Chemistry II	72	3	3	60	40	10	50
III	**3C03 MAT-CH**	Mathematics for Chemistry III	90	3	3	60	40	10	50
IV	**4C04 MAT-CH**	Mathematics for Chemistry IV	90	3	3	60	40	10	50
Total			**---**	**12**	**----**	**240**	**160**	**40**	**200**

Scheme of Complementary Course- Mathematics for Statistics

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 MAT-ST**	Mathematics for Statistics I	72	3	3	60	40	10	50
II	**2C02 MAT-ST**	Mathematics for Statistics II	72	3	3	60	40	10	50
III	**3C03 MAT-ST**	Mathematics for Statistics III	90	3	3	60	40	10	50
IV	**4C04 MAT-ST**	Mathematics for Statistics IV	90	3	3	60	40	10	50
Total			---	**12**	----	**240**	**160**	**40**	**200**

Scheme of Complementary Course- Mathematics for Computer Science

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 MAT-CS**	Mathematics for Computer Science I	72	3	3	60	40	10	50
II	**2C02 MAT-CS**	Mathematics for Computer Science II	72	3	3	60	40	10	50
III	**3C03 MAT-CS**	Mathematics for Computer Science III	90	3	3	60	40	10	50
IV	**4C04 MAT-CS**	Mathematics for Computer Science IV	90	3	3	60	40	10	50
Total			---	**12**	----	**240**	**160**	**40**	**200**

Scheme of Complementary Course- Mathematics for BCA

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 MAT-BCA**	BCA Mathematics I	72	3	3	60	40	10	50
II	**2C02 MAT-BCA**	BCA Mathematics II	72	3	3	60	40	10	50
III	**3C03 MAT-BCA**	BCA Mathematics III	90	3	3	60	40	10	50
IV	**4C04 MAT-BCA**	BCA Mathematics IV	90	3	3	60	40	10	50
Total			---	**12**	----	**240**	**160**	**40**	**200**

Scheme of Complementary Course- Astronomy

Semester	Course Code	Title of the Course	Contact hours	Credits	Ext. Exam Hours	Marks			
						External		Internal	Total
						Agg.	Max.		
I	**1C01 AST**	Astronomy I	72	3	3	60	40	10	50
II	**2C02 AST**	Astronomy II	72	3	3	60	40	10	50
III	**3C03 AST**	Astronomy III	90	3	3	60	40	10	50
IV	**4C04 AST**	Astronomy IV	90	3	3	60	40	10	50
Total			**---**	**12**	**----**	**240**	**160**	**40**	**200**

EVALUATION AND GRADING

The evaluation scheme for each course shall contain two parts; (a) Internal Assessment and (b) External Evaluation. 20% weight shall be given to the internal assessment. The remaining 80% weight shall be for the external evaluation. Evaluation (both Internal and External) is carried out using Mark System instead of direct grading. For each course in the semester letter grade, grade point and % of marks are introduced in 7- point Indirect Grading System. Indirect Grading System in 7 point scale is as below:

Seven Point Indirect Grading System

% of Marks	Grade	Interpretation	Grade Point Average (G)	Range of Grade Points	Class
90 and above	A+	Outstanding	6	5.5 – 6	First class with Distinction
80 to below 90	A	Excellent	5	4.5 - 5.49	
70 to below 80	B	Very good	4	3.5 - 4.49	First class
60 to below 70	C	Good	3	2.5 - 3.49	
50 to below 60	D	Satisfactory	2	1.5 - 2.49	Second class
40 to below 50	E	Pass / Adequate	1	0.5 - 1.49	Pass
Below 40	F	Failure	0	0 - 0.49	Fail

INTERNAL ASSESSMENT (IA)

The internal assessment of theory courses, practical courses and project shall be based different components. The components with percentage of marks are as follows:

1. Core/Complementary/Open Courses

Sl.No	Components	% of Marks allotted	Marks Allotted		
			Core courses	**Complimentary Course**	**Open course**
1	Attendance	25	3	2.5	1.25
2	Assignment/ Seminar/Viva -voce	25	3	2.5	1.25
3	Test paper	50	6	5	2.5
Total		**100**	**12**	10	**5**

(If a fraction appears in internal marks, nearest whole number is to be taken)

- **Assignment/ Seminar/ Viva-Voce:** For each theory course, each student is required to submit an assignment or to present a seminar or to attend a viva-voce based on any topic related to the course concerned. Assignment/ seminar/viva-voce shall be evaluated on the basis of student's performance.
- **Written Tests**: For each theory course there shall be a minimum of two written tests and the average mark of the two tests is to be considered for Internal Mark. Each test paper may have duration of minimum one hour.
- **Attendance**: Attendance of each Course will be evaluated as below:

SN	% of Attendance	% of Marks allotted	Marks Allotted		
			Theory & Practical (Core)	Theory & Practical (Complementary)	Open course
1	Above 90	100	3	2.5	1.25
2	85 to 89	80	2.4	2	1
3	80 to 84	60	1.8	1.5	0.75
4	76 to 79	40	1.2	1	0.5
5	75	20	0.6	0.5	0.25
Total		**100**	---	--	----

2. Project

Sl.No	Components	% of Marks allotted	Marks Allotted
1	Seminar Presentation/ Punctuality	20	1.5
2	Relevance of the Topic and content/ Use of Data	20	1.5
3	Scheme/Organization of Report/Layout	30	2
4	Viva-Voce	30	2
Total		**100**	**7**

EXTERNAL EVALUATION
(END SEMESTER EVALUATION - ESE)

Details regarding the End Semester Evaluation of theory, practical and project courses are given below:

1. Core Courses

- Maximum Marks for each course - 48 Marks
- Duration of examination - 3 Hrs.

Section	Mark for each question	Number of Questions		Total Marks	
		Total	Required	Aggregate	Maximum
A	1	4	4	4	4
B	2	10	8	20	16
C	4	6	4	24	16
D	6	4	2	24	12
Total	----	24	18	72	48

2. Complementary Courses

- Maximum Marks for each course - 40 Marks
- Duration of examination - 3 Hrs.

Section	Mark for each question	Number of Questions		Total Marks	
		Total	Required	Aggregate	Maximum
A	1	4	4	4	4
B	2	9	7	18	14
C	3	6	4	18	12
D	5	4	2	20	10
Total	----	23	17	60	40

3. Open Course

- Maximum Marks for open course - 20 Marks
- Duration of examination - 2 Hrs.

Section	Mark for each question	Number of Questions		Total Marks	
		Total	Required	Aggregate	Maximum
A	1	4	4	4	4
B	2	9	6	18	12
C	4	2	1	8	4
Total	----	15	11	30	20

4. Project

The project evaluation with viva-voce shall be done by the external examiner based on the assessment of following components. This will be done along with the Practical Examination.

Sl.No	Components	% of Marks allotted	Marks Allotted
1	Relevance of the Topic---Reference/ Bibliography	20	5.6
2	Presentation - -Findings and Recommendations	30	8.4
3	Viva-Voce	50	14
Total		**100**	**28**

Sd/-
Prof. Jeseentha Lukka
Chairperson, BOS in Mathematics (UG).

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The SGPA, CGPA and OGPA for the programme will be calculated as per the Regulations for Choice Based Credit and Semester System for Undergraduate Curriculum- 2014.

Syllabus for B.Sc. Mathematics (Core)

1B01 MAT: Differential Calculus

Module-I (18 Hours)

Limit and continuity, The Sandwich theorem, Target values and formal definition of limits, Continuity. (Section 1.2, 1.3, and 1.5 of Text 3)

Inverse functions and their derivatives, Derivatives of inverse trigonometric function, Hyperbolic function and derivatives (Section 6.1, 6.9, 6.10 of Text 3). Successive differentiation, Standard results - n^{th} derivatives, Leibnitz's theorem.

(Sections 4.1 to 4.3 of Text 2)

Module II (15 Hours)

Polar co-ordinates, Equation for a line in polar co-ordinates, Cylindrical polar co-ordinates, Spherical polar co-ordinates, Sphere, cylinder and cone. (Sections 2.1.3, 2.1.4, 2.1.6, 2.1.7, 2.3.5, 2.3.6 and 2.3.7 of Text 1)

Module-III (21 Hours)

Rolle's theorem, Lagrange's mean value theorem, Taylor's theorem, Maclaurin series, Taylor series, Polar curves, Derivative of arc, curvature, radius of curvature (except radius of curvature for pedal curve), Centre of curvature, Evolute and involute, Increasing and decreasing functions, Maxima and minima, Asymptote (Sections 4.3 to 4.7, 4.10, 4.12 to 4.15, 4.17, 4.18, 4.20 of Text 2). L Hospital's rule - Indeterminate forms, Concavity, Convexity and point of inflection. (Section 3.4 and 6.6 of Text 3)

Module-IV (18 Hours)

Functions of several variables, Limits and continuity, Partial derivatives, Differentiability linearization and differentials, Chain rule (Sections 12.1 to 12.5 of Text 3). Homogeneous functions, Euler's theorem on homogeneous functions. (Sections 11.8 and 11.8.1 of Text 4)

Texts:
1. S. S. Sastry, Engineering Mathematics, Vol. 1, 4th Edition, PHI
2. B.S. Grewal, Higher Engineering Mathematics, 36th Edition
3. G. B. Thomas and R. L. Finney, Calculus and Analytic geometry, 9th Edition.
4. S. Narayan and P. K. Mittal, Differential Calculus, Revised Edition, S. Chand Publishing

References:

1. M. D. Weir, J. Hass and F. G. Giordano, Thomas' Calculus, 11th Edition, Pearson.
2. H. Anton, I. Bivens and S. Davis, Calculus, 7th Edition, Wiley.
3. S. K. Stein, Calculus with Analytic Geometry, McGraw Hill.
4. G. F Simmons, Calculus with Analytic Geometry, 2nd Edition, McGraw Hill.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	18	18	12	12	60	4
II	15	12	8			
III	21	24	16			
IV	18	18	12			
Total	72	72	48	12	60	

2B02 MAT: Integral Calculus

Module – I (18 hours)

Riemann sum and definite integrals, Properties, Mean Value theorem for definite integrals, Fundamental theorem of calculus (without proof), Substitution in definite integrals, Integration of hyperbolic functions, Reduction formulae.
(Section 4.5 to 4.8 , 6.10 and 7.5 of Text 1)

Module - II (15 hours)

Improper integrals, Improper integrals of first, second and third kinds, Cauchy principal value, Beta and Gamma function and properties. (Chapter 12 and 13 of Text 2)

Module – III (21 hours)

Quadric surfaces (Section 2.3.8 of Text 3). Application of integration- Area between curves, Volume of solid of revolution length of curves, Length of parameterized curves, Area of surface of revolution, integration in parametric and polar co-ordinates.
(Section 5.1, 5.3, 5.5, 5.6, 9.5, 9.9 of Text 1)

Module - IV (18 hours)

Multiple integrals, Double integrals, area of bounded region in the plane, (excluding Moments and Centers of Mass) double integral in polar form, triple integral in rectangular co ordinates, triple integral in cylindrical and spherical co-ordinates, substitution in multiple integrals. (section 13.1 to 13.4, 13.6, 13.7 of Text 1)

Texts:
1. G. B. Thomas and R. L. Finney, Calculus, 9th Edition .
2. M.R. Spiegel, Theory and Problems of Advanced Calculus, Schaum's Series.
3. S. S. Sastry, Engineering Mathematics, Vol. 1, 4th Edition, PHI

References:

1. S. Narayanan and T.K.M. Pillay, Differential and Integral Calculus, S. Viswanathan Printers and Publishers, Chennai.
2. H. Anton, I. Bivens and S. Davis, Calculus, 7th Edition, Wiley.
3. S. K. Stein, Calculus with Analytic Geometry, McGraw Hill.

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
<tr><th>Aggregate Mark</th><th>Maximum Mark</th></tr>
<tr><td>I</td><td>18</td><td>18</td><td>12</td><td rowspan="4">12</td><td rowspan="4">60</td><td rowspan="5">4</td></tr>
<tr><td>II</td><td>15</td><td>15</td><td>10</td></tr>
<tr><td>III</td><td>21</td><td>21</td><td>14</td></tr>
<tr><td>IV</td><td>18</td><td>18</td><td>12</td></tr>
<tr><td>Total</td><td>72</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

3B03 MAT: Elements of Mathematics I

Module – I (18 hours)

Finite and Infinite sets, Countable and uncountable sets, Cantor's theorem, Logic and proofs (Section 1.3 and Appendix A of text 4)

Arguments, Logical implications, Propositional functions, Quantifiers, Negation of quantified statements. (Sections 10.9 to 10.12 of Text 1)

Module – II (27 hours)

Basic concepts, Relation between roots and coefficients, Symmetric functions of roots, Sum of the powers of roots, Newton's theorem on sum of the powers of roots, Transformation of equations, Reciprocal equations, Transformation in general. (Chapters 6: Sec 1 to 16 and 21 of Text 2)

Module - III (20 hours)

Descartes rule of signs, Multiple roots, Sturm's theorem, Cardon's method, Solution of biquadratic equation (Chapters 6: Sec 24, 26, 27, 34.1 and 35 of Text 2). Fundamental theorem of algebra (without proof), Trigonometric series. (Relevant topics in Section III-Chapter 1 and Section II- Chapter 2 of Text 3)

Module - IV (25 hours)

Divisibility theory in the integers – the division algorithm, the greatest common divisor, the Euclidean algorithm, the Diophantine equation ax + by = c. Primes and their distribution-fundamental theorem of arithmetic, the sieve of Eratosthenes. The theory of congruence-basic properties of congruence. (Sections 2.2, 2.3, 2.4, 2.5, 3.1, 3.2, 4.2of Text 5)

Texts:
1. S. Lipschitz, Set Theory and Related Topics, 2nd Edition, Schaum's series.
2. T. K. Manicavachagom Pillai, T. Natarajan and K. S. Ganapathy, Algebra Vol-1, S Viswanathan Printers and Publishers, 2010.
3. K. Khurana and S. B. Malik, Elementary topics in Algebra, Vikas Publishing House pvt. Ltd., 2nd Edition.
4. R. G. Bartle & Donald R. Sherbert, Introduction to Real Analysis, 3rd Edition, Wiley.
5. D. M. Burton, Elementary Number Theory, 7th Edition, TMH

References:

1. C.Y. Hsiung, Elementary Theory of Numbers, Allied Publishers.
2. N. Robbins, Beginning Number Theory, Second Edition. Narosa.
3. G. E. Andrews, Number Theory, HPC.
4. M.D. Raisinghnia and R.S. Aggarwal, Algebra.
5. K.H. Rosen, Discrete Mathematics and its Applications, 6th Edition, Tata McGraw Hill Publishing Company, New Delhi.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	18	15	10	12	60	4
II	27	21	14			
III	20	15	10			
IV	25	21	14			
Total	90	72	48	12	60	

4B04 MAT: Elements of Mathematics II

Module I (25 Hours)

Relations, Types of relations, Partitions, Equivalence relation, Partial ordering relation, Functions, Composition of functions, One to one, Onto and invertible functions, Mathematical functions (except exponential and logarithmic functions), Recursively defined functions. (Sections 3.3, 3.6, 3.8, 3.9, 3.10 and chapter 4 of Text 1)

Module II (20 Hours)

Ordered sets, Partially ordered sets and Hasse diagrams, Minimal and maximal elements, First and last elements, Supremum and infimum, Lattices. Bounded, distributive, Complemented lattices. (Chapter 7: Sections 7.2, 7.4, 7.5, 7.7, 7.10, 7.11 of Text 1)

Module III (25 Hours)

Chords of contact of tangents from a given point, Pair of tangents from a point, pole and polar with respect to conic sections, conjugate points, conjugate lines, Equation of a chord in terms of middle point, Parametric representation of points on conics, Asymptotes of hyperbola. (Relevant Sections from Text 2)

Module –IV (20 Hours)

Rank of a matrix – Elementary transformation, reduction to normal form, row reduced echelon form, computing the inverse of a non singular matrix using elementary row transformation. (Section 4.1 to 4.13 of Text 3)

Texts:
1. S. Lipschitz, Set Theory and Related Topics, 2nd Edition, Schaum's Series.
2. T. K. Manicavachagam Pillay and T . Natarajan, Calculus and Co-ordinate Geometry.
3. S. Narayanan and Mittal, A Text Book of Matrices, Revised Edition, S. Chand.

References:
1. P. R. Vital, Analytical Geometry, Trigonometry and Matrices, Pearson Education
2. P.R. Halmos, Naive Set Theory, Springer.
3. E. Kamke, Theory of Sets, Dover Publishers.
4. D. Serre, Matrices, Theory and Applications, Springer.

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
<tr><th>Aggregate Mark</th><th>Maximum Mark</th></tr>
<tr><td>I</td><td>25</td><td>22</td><td>15</td><td rowspan="4">12</td><td rowspan="4">60</td><td rowspan="5">4</td></tr>
<tr><td>II</td><td>20</td><td>14</td><td>9</td></tr>
<tr><td>III</td><td>25</td><td>22</td><td>15</td></tr>
<tr><td>IV</td><td>20</td><td>14</td><td>9</td></tr>
<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
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5B05 MAT: Real Analysis

Module - I (25 Hours)

The algebraic property of real numbers, The absolute value and Real line, The completeness property of R, Applications of the supremum property, Intervals.
(Sections 2.1 to 2.5)

Module - II (20 Hours)

Sequence and their limits, Limit theorems, Monotone sequences, Subsequence and Bolzano-Weirstrass theorem, Cauchy criterion.
(Sections 3.1 to 3.5)

Module - III (25 Hours)

Introduction to series, Absolute convergence, Tests for absolute convergence, Tests for non absolute convergence.
(Sections 3.7, 9.1, 9.2, 9.3)

Module - IV (20 Hours)

Continuous functions, Combination of continuous functions, Continuous functions on intervals - Uniform continuity, monotone and inverse functions.
(Sections 5.1 to 5.4, 5.6)

Text: R. G. Bartle and D. R. Sherbert, Introduction to Real Analysis, 3rd Edition, Wiley.

References:

1. T. M. Apostol, Mathematical Analysis, 2nd Edition, Addison- Wesley.
2. V. Karunakaran, Real Analysis, Pearson Education.
3. K.A. Ross , Elementary Real Analysis, The Theory of Calculus, Springer
4. J.V. Deshpande, Mathematical Analysis and Applications, Narosa Pub. House.
5. J. M. Howie, Real Analysis, Springer 2007.
6. Ghorpade and Limaye , A Course in Calculus and Real Analysis, Springer, 2006

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>I</td><td>25</td><td>21</td><td>14</td><td rowspan="4">12</td><td rowspan="4">60</td><td rowspan="5">4</td></tr>
<tr><td>II</td><td>20</td><td>15</td><td>10</td></tr>
<tr><td>III</td><td>25</td><td>21</td><td>14</td></tr>
<tr><td>IV</td><td>20</td><td>15</td><td>10</td></tr>
<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

5B06 MAT: Abstract Algebra

Module - I (20 Hours)

Binary operations. Groups - Definition and examples, Elementary properties of groups, Finite groups and group tables. Subgroups –Subsets and Subgroups, Cyclic subgroups. Cyclic groups - Elementary properties of cyclic groups, Structure of cyclic groups, Subgroups of finite cyclic groups. (Sections 2, 4, 5, 6)

Module - II (25 Hours)

Groups of permutations – Cayley's theorem. Orbits, cycles and alternating groups (Theorem 9.15 without proof). Cosets and theorem of Lagrange. (Sections 8, 9, 10)

Module - III (20 Hours)

Homomorphisms - Structure relating maps, properties of homomorphism. Factor Groups- Factor groups from homomorphism, Fundamental homomorphism theorem.
(Sections 13,14)

Module - II (25 Hours)

Rings and fields- Homomorphism and isomorphism. Integral domains - Divisors of zero and cancellation, Characteristic of a ring. Fermat's and Euler's theorems.
(Sections 18, 19, 20)

Text: J. B. Fraleigh , A First Course in Abstract Algebra, 7th Edition, Pearson.

References:

1. M. Artin, Algebra, Prentice Hall, 1991.
2. I. N. Herstein, Topics in Algebra, Wiley, 2nd Edition
3. U.M. Swami and A.V.S.N. Murthi, Abstract Algebra, Pearson Education.
4. J. A. Gallian, Contemporary Abstract Algebra, Narosa Pub. House.
5. P. B. Bhattacharya, S.K. Jain and S.R. Nagpaul, Basic Abstract Algebra, 2nd Edition, Cambridge University Press.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	15	10	12	60	4
II	25	21	14			
III	20	15	10			
IV	25	21	14			
Total	90	72	48	12	60	

5B07 MAT: Differential Equations, Laplace Transform and Fourier Series

Module I: First Order Differential Equations (20 Hours)

Basic concepts and ideas, Separable differential equations, Exact differential equations. Integrating factors, Linear differential equations. Bernoulli equation, Orthogonal trajectories of curves, Existence and uniqueness of solutions (Sections 1.1, 1.3, 1.5, 1.6, 1.8 and 1.9 of Text 1). Systems of Differential Equations - Introductory examples, Basic concepts and theory. (Sections 3.1, 3.2)

Module II: Second Order Linear Differential Equations (25 Hours)

Homogeneous linear equations of second order, Second order homogeneous equation with constant coefficients, Case of complex roots, Complex exponential function, Differential operators, Euler-Cauchy equation, Existence and uniqueness theory (proof omitted), Wronskian, Non homogeneous equations, Solution by undetermined coefficients, Solution by variation of parameters. (Sections 2.1 to 2.10 except 2.5)

Module III: Laplace Transform (22 Hours)

Laplace transform, Inverse transform, Linearity, Transforms of derivatives and integrals, Unit step function, second shifting theorem, Dirac's Delta function, Differentiation of integration of transforms, Convolution, Partial Fractions. Differential equations. (Sections 5.1 to 5.6)

Module IV: Fourier Series (23 Hours)

Periodic functions. Trigonometric series, Fourier series, Functions of any period p=2L, Even and odd functions, Half range expansion, Fourier integrals (Sections 10.1 to 10.4 and 10.8).

Text : E. Kreyzig, Advanced Engineering Mathematics, 8th Edition, John Wiley, 2006.

References:

1. S.L. Ross, Differential Equations, 3rd Edition, Wiley.
2. G. Birkhoff and G.C. Rota, Ordinary Differential Equations, Wiley and Sons, 3rd Edition
3. E.A. Coddington, An Introduction to Ordinary Differential Equtions, Printice Hall
4. W.E. Boyce and R.C.Diprima, Elementary Differential Equations and Boundary Value Problems, 9th Edition, Wiley.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	16	10	12	60	4
II	25	20	14			
III	22	18	12			
IV	23	18	12			
Total	90	72	48	12	60	

5B08 MAT: Vector Calculus

Module - I (18 Hours)

Lines and planes in space, Vector functions, Arc length and Unit Tangent Vector **T,** Curvature and Unit Normal Vector **N** , Torsion and Unit Binormal Vector **B** .(Sections 12.5, 13.1, 13.3 to 13.5 of Text 1)

Module - II (24 Hours)

Directional derivatives and gradient vectors, Tangent planes and differentials, Extreme values and saddle points, Lagrange multipliers, Partial derivatives with constrained variables, Taylor's formula for two variables (Sections 14.5 to 14.10 of Text 1). Divergence of a vector field, Curl of a vector field. (Sections 8.10 and 8.11 of text 2)

Module - III (15 Hours)

Line integrals, Vector fields, work, circulation, flux, Path independence, potential functions, conservative fields, Green's theorem in the plane.
(Sections 16.1 to 16.4 of Text 1)

Module - IV (15 Hours)

Surface area and surface integrals, Parameterized surfaces, Stokes' theorem (theorems without proof), Divergence theorem and unified theory (theorems without proof)—(Sections 16.5 to 16.8 of Text 1)

Texts: 1. M. D. Weir, J. Hass and F. G. Giordano, Thomas' Calculus, 11^{th} Edition, Pearson Education.
2. E. Kreyzig, Advanced Engineering Mathematics, 8^{th} Edition, John Wiley, 2006.

References

1. G. B. Thomas and R. L. Finney, Calculus, 9^{th} Edition, LPE, Pearson Education
2. H. F. Davis and A. D. Snider, Introduction to Vector Analysis, 6^{th} Eddition, Universal Book Stall, New Delhi.
3. F. W. Bedford and T. D. Dwivedi, Vector Calculus, McGraw Hill Book Company

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<tr><td>II</td><td>24</td><td>24</td><td>16</td></tr>
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<tr><td>Total</td><td>72</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

5B09 MAT: Graph Theory

Module I – Basic Results (18 Hours)

Introduction, Basic Concepts, Subgraphs, Degrees of Vertices, Paths and Connectedness, Line Graphs (Whitney's theorem without proof), Operations on Graphs.
(Sections 1.1 to 1.8 except 1.6)

Module II –Connectivity, Trees (24 Hours)

Introduction, Vertex Cuts and Edges Cuts, Connectivity and Edge Connectivity (Whitney's theorem without proof), Blocks, Introduction, Definition, Characterization, and Simple Properties, Centers and Centroids, Counting the Number of Spanning Trees, Cayley's Formula. (Sections 3.1 to 3.4 and 4.1 to 4.5)

Module III – Independent Sets, Eulerian and Hamiltonian Graphs (18 Hours)

Introduction, Vertex-Independent Sets and Vertex Coverings, Edge-Independent Sets, Introduction, Eulerian Graphs, Hamiltonian Graphs, Hamilton's "Around the World" Game. (Sections 5.1 to 5.3, and 6.1 to 6.3 and 6.3.1)

Module IV – Directed Graphs (12 Hours)

Introduction, Basic Concepts, Tournaments (Sections 2.1 to 2.3)

Text: R. Balakrishnan and K. Ranganathan, A Text Book of Graph Theory, 2^{nd} Edition, Springer

References:

1. J.A. Bondy and U.S.R.Murty, Graph Theory with applications. Macmillan
2. F. Harary, Graph Theory, Narosa publishers
3. J. Clark and D. A. Holton, A First look at Graph Theory, Prentice Hall
4. K.R. Parthasarathy, Basic Graph Theory, Tata-McGraw Hill
5. J.A. Dossey, Discrete Mathematics, Pearson Education.

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<tr><td>I</td><td>18</td><td>18</td><td>12</td><td rowspan="4">12</td><td rowspan="4">60</td><td rowspan="5">3</td></tr>
<tr><td>II</td><td>24</td><td>24</td><td>16</td></tr>
<tr><td>III</td><td>18</td><td>18</td><td>12</td></tr>
<tr><td>IV</td><td>12</td><td>12</td><td>8</td></tr>
<tr><td>Total</td><td>72</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

6B10 MAT: Linear Algebra

Module I - Vector Spaces (22 Hours)

Introduction, Vector spaces, Subspaces, Linear Combinations and Systems of Linear Equations, Linear Dependence and Linear Independence, Bases and Dimension, Maximal Linearly Independent Subsets. (Sections 1.1 to 1.7 of Text1)

Module II – Linear Transformations and Matrix Representations (18 Hours)

Linear Transformations, Null Spaces, and Ranges, The Matrix Representation of a Linear Transformation, Composition of Linear Transformations and Matrix Multiplication (theorems without proof). (Sections 2.1 to 2.3 of Text1)

Module III – System of Linear Equations (32 Hours)

System of linear homogeneous equations. Null space and nullity of matrix. Sylvester's law of nullity. Range of a matrix. Systems of linear non homogeneous equations. Characteristic roots and characteristic vectors of a square matrix. Some fundamental theorems (without proof). Characteristic roots of Hermitian, Skew Hermitian and Unitary matrices. Characteristic equation of a matrix, Cayley-Hamilton theorem. (Relevant topics in the sections 6.1 to 6.6, 6.8 and 11.1 to 11.3, and 11.11 of Text 2)

Module - IV Numerical Methods for Linear System of Equations (18 Hours)

Diagonalizability (Section 5.2 of Text 1). Gauss elimination, Gauss-Jordan Method, Modification of Gauss method to compute the inverse. (Sections 6.3.2 to 6.3.4 of Text 3)

Text: 1. S. H. Friedberg, Arnold J. Insel and Lawrence E. Spence, Linear Algebra, 2nd Edition, PH Inc.
2. S. Narayanan and Mittal, A Text Book of Matrices, Revised Edition, S. Chand
3. S. S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

References:

1. R. R. Stoll and E. T. Wong, Linear Algebra Academic Press International Edn (1968)
2. G. D. Mostow and J.H. Sampson, Linear Algebra, McGraw-Hill Book Co NY (1969)
3. S. Kumaresan, Linear Algebra-A Geometric Approach, Prentice Hall of India (2000)
4. J. B. Fraleigh and R.H. Beauregard , Linear Algebra, Addison Wesley
5. P. Saika, Linear Algebra, Pearson Education.

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<tr><td>IV</td><td>18</td><td>15</td><td>10</td></tr>
<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

6B11MAT: Numerical Methods and Partial Differential Equations

Module I : Solution of Algebraic and Transcendental Equation(15 Hours)

Introduction to solution of algebraic and transcendental equation, Initial approximations, Bisection method, Regula-falsi method, Newton-Raphson method, General iteration method. (Sections 3.2, 3.2.1, 3.3, 3.4, 3.5, 3.6 of Text 1)

Module II: Interpolation (20 Hours)

Interpolation with unevenly spaced points, Langrange interpolation, Newton's divided differences interpolation, Finite difference operators and finite differences, Newton's interpolation formulae, Central difference interpolation.
(Sections 4.2, 4.2.1, 4.2.3, 4.3.1, 4.3.2, 4.3.3 of Text 1)

Module III: Numerical Differentiation and Integration (15 Hours)

Introduction, Numerical differentiation, Numerical differentiation using difference formulae (without error estimation), Numerical integration, Trapezoidal rule, Simpson's rule. (Sections 6.1, 6.2, 6.2.1, 6.3, 6.3.1, 6.3.2 of Text 1)

Module IV: Numerical Solutions of Ordinary Differential Equations (15 Hours)

Introduction, Picard's method, Solution by Taylor series method, Euler method, Runge-Kutta methods. (Sections 7.1 to 7.5 of Text 1)

Module V – Partial Differential Equations (25 Hours)

Basic concepts, Separation of variables. Use of Fourier series, D'Alembert's solution of the wave equation, Heat equation- Solution by Fourier series, Laplacian in polar coordinates. (Sections 11.1, 11.3 to 11.5 and 11.9 of Text 2)

Text: 1. S. R. K. Iyengar and R. K. Jain, Mathematical methods, Narosa Publishing House.
2. E. Kreyzig, Advanced Engineering Mathematics, 8th Edition, John Wiley

References:

1. S.S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, PHI.
2. F.B. Hidebrand, Introduction to Numerical Analysis, TMH.
3. W.E. Boyce and R.C. Deprima, Elementary Differential Equations and Boundary Value Problems, Wiley 9th Edition.
4. P. Duchateau and D. W. Zachmann, Theory and Problems of Partial Differential Equations, Schaum's Outline Series.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	15	12	8	12	60	4
II	20	15	10			
III	15	12	8			
IV	15	12	8			
V	25	21	14			
Total	90	72	48	12	60	

6B12MAT: Complex Analysis

Module I : Complex Numbers and Functions (25 Hours)

Complex numbers, Complex plane, Polar form of complex numbers powers and roots, Derivative, Analytical function, Cauchy-Riemann equations, Laplace equation, Exponential--Trigonometric -- Hyperbolic functions (without mapping), Logarithm and general power. (Sections 12.1 to 12.8 except 12.5)

Module II: Complex Integration (23 Hours)

Line integral in the complex plane, Cauchy's integral theorem (Theorem-1 without proof), Cauchy's integral formula, Derivatives of Analytic functions, Cauchy's Inequality, Liouville's and Moreras theorems. (Sections 13.1 to 13.4)

Module III: Power series and Taylor series (22 Hours)

Sequences, series, Convergence tests, Ratio test, Root test, Power series, radius of convergence of a power series. Taylor series and Maclaurin series, Taylor's Theorem (without proof), important special Taylor series. (Sections 14.1, 14.2, 14.4)

Module IV: Laurent Series, Residue Integration (20 Hours)

Laurent series, Laurent Theorem (without proof), Singularities and zeros, Zeros of Analytic functions, Analytic or Singular at Infinity, Residue integration method, residue theorem. (Sections 15.1 to 15.3)

Text: E. Kreyzig, Advanced Engineering Mathematics, 8th Edition, John Wiley, 1993.

References:

1. J. W. Brown and R. V. Churchill, Complex Variables and Applications,8th Edition, McGraw Hill.
2. M. J.Ablowitz and A. S. Fokas, Complex Variables, Cambridge Text, 2nd Edition.
3. S. Ponnusamy, Foundation of Complex Analysis : Narosa.
4. M. R. Spiegel, Complex Variables, Schaum's Outline series.
5. J. M. Howie, Complex Analysis, Springer India Reprint.

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<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>II</td><td>23</td><td>18</td><td>12</td></tr>
<tr><td>III</td><td>22</td><td>18</td><td>12</td></tr>
<tr><td>IV</td><td>20</td><td>15</td><td>10</td></tr>
<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

6B13MAT: Mathematical Analysis and Topology

Module I: (25 Hours)

Riemann integral: The Riemann integrability, Properties of Riemann integral, The Fundamental theorem of calculus, The integral as a limit, Aproximate integration.
(Sections: 7.1 to 7.5 of Text 1)

Module II : (20 Hours)

Sequence & series of functions: Point wise and uniform convergence – Interchange of limits – Series of Functions.
(Sections: 8.1, 8.2, 9.4 of Text 1)

Module III: Metric Spaces (22 Hours)

The definition and some examples, open sets, closed sets, convergence, completeness and Baire's theorem. (Chapter 2, sections 9, 10, 11, 12 from Text 2)

Module IV: Topological Spaces (23 Hours)

The definition and some examples, Elementary concepts.
(Chapter 3, sections 16, 17 of Text 2)

Texts :
1. G. Bartle, D. R. Sherbert, Introduction to Real Analysis. 2nd Edition.
2. G. F. Simmons, Introduction to Topology and Modern Analysis, McGraw-Hill. International Student Edition.

References:

1. J. V. Deshpande, Mathematical Analysis and Applications, Narosa Pub. House.
2. K. A. Ross, Elementary Real Analysis, Theory of Calculus, Springer.
3. K. G. Binmore, Mathematical Analysis, CUP.
4. S. Kumaresan, Topology of Metric Spaces, Alpha Science Intl. Ltd, 20055.
5. G. L. Cain, Introduction to General Topology, Pearson Company.
6. M. A. Armstrong , Basic Topology, Springer Verlag New York 1983.
7. J. R. Munkres, Topology- a First Course, PHI.

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<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

Elective

Elective is to be chosen as one of the following courses

6B14A MAT: Operations Research
6B14B MAT: Mathematical Economics
6B14C MAT: Classical Mechanics
6B14D MAT: Programming in Python

(See the syllabus of elective courses in **Annexure I**)

6B15 MAT: Project

- Project dissertation (project report) should be submitted to the university in typed format.
- The report should have at least 20 pages.
- Project can do individually or as a group comprising a maximum of 4 students
- External valuation and viva-voce of the project shall be done (individually).
- The pass condition shall be 14 marks which is 40% of the 35 marks.
- The project report should contain a Title Page, Certificate from the project guide counter signed by the Head of the Department, List of Contents, Preface and List of References.

The project evaluation and viva-voce shall be done by the external examiner based on the assessment of following components. Criterion for internal evaluation is also included in the table.

Sl.No.	External		Internal		Total Mark	Credit
	Components	**Mark**	**Components**	**Mark**		
1	Relevance of the Topic ---Reference/ Bibliography	5.6	Relevance of the Topic and content/ Use of Data	1.5	35	2
2	Viva - Voce	14	Viva-Voce	2		
3	Presentation ---Findings and Recommendations	8.4	Seminar Presentation/ Punctuality	1.5		
4		--	Scheme/Organization of Report/Layout	2		
Total		28		7	35	

References:

1. L. Lamport, LaTeX a Document Preparation System User's Guide and Reference Manual, Pearson Education Publications.
2. J. Gibaldi, W. S. Achtert and D. G. Nicholls, MLA Handbook for Writers of Research Papers, Published by Modern language Association of America 209.
3. S. G. Krantz, a Primer of Mathematical Writing, Universities Press.
4. Website: http//: www. Chicago Manual of Style.

ANNEXURE I : Electives

6B 14A MAT: Operations Research

Module – I (30 hours)

Operations Research – An overview (Chapter – 1) Convex sets and their properties (section 0.13, proof of theorem 0.4 omitted), Convex function, Local and global extreme, Quadratic forms (Section 0.15 to 0.17).

General linear programming problem – canonical and standard forms of L.P.P (sections 3.4. 3.5), Solutions and fundamental properties of solutions of LPP (sections 4.1. 4.2 theorems without proof), Graphical solution method (section 3.2), Simplex method (section 4.3), Duality in linear programming – General primal – dual pair, Formulating a dual problem. (Sections 5.1 to 5.3)

Module – II (30 hours)

Transportation problem: General transportation problem, the transportation tables, Loops in transportation table solution of a transportation problem, Finding an initial basic feasible solution, Test for optimality, Degeneracy in transportation problem, Transportation algorithm (MODI method).
(Sections 10.1, 10.2, 10.3, 10.5, 10.8, 10.9, 10.10, 10.11, 10.12)

Assignment Problem: Introduction, Mathematical formulation, Solution methods of Assignment problem (Ssections 11.1 to 11.3).

Module – III (30 hours)

Sequencing problem: Problem of sequencing, Basic terms used in sequencing, Processing n job through two machines, Processing n jobs through k machines, Processing 2 jobs through k machines, maintenance crew scheduling. (Sections 12.1 to 12.7)

Games and strategies: Introduction, Two- person zero-sum games, Some basic terms, The maximin – minimax principle, Games without saddle points – mixed strategies, Graphic solution of 2xn and nx2 games, Dominance property, Arithmetic method for nxn games. (Section 17.1 to 17.8)

Text: K. Swarup, P.K. Gupta and M. Mohan, Operations Research (12^{th} Edition), Sulthan Chand.

References:

1. J. K. Sharma, Operations Research Theory and Applications. McMillan, New Delhi.
2. G. Hadley, Linear Programming,Oxford & IBH Publishing Company, New Delhi.
3. H. A. Thaha, Operations Research, An Introduction, 8^{th} Edition , Prentice Hall.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	30	24	16	12	60	3
II	30	24	16			
III	30	24	16			
Total	90	72	48	12	60	

6B14B MAT: Mathematical Economics

MODULE I– Equilibrium Analysis in Economics (25 Hours)

The meaning of equilibrium, Partial market equilibrium- A linear model, Partial market equilibrium- A non-linear model, General market equilibrium, Equilibrium in national income analysis. (Sections 3.1 to 3.5)

MODULE –II Matrix Analysis (20 Hours)

Applications to market and national income models, Leontif input-output model.
(Sections 5.6 and 5.7)

MODULE –III Further topics in Optimization (25 Hours)

Non-linear programming and Kuhn-Tucker conditions, The constraint qualification, Economic applications. (Sections 13.1 to 13.3)

MODULE –IV Applications of Integration (20Hours)

Some economic applications of integrals, Domar growth model. (Sections 14.5 and 14.6)

Text : A. C. Chiang and K. Wainwright, Fundamental Methods of Mathematical Economics, 4th Edition, 2005

Reference:

1. B.M Aggarwal, Business mathematics and statistics Ane Books Pvt. Ltd.

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>I</td><td>25</td><td>18</td><td>12</td><td rowspan="4">12</td><td rowspan="4">60</td><td rowspan="5">3</td></tr>
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<tr><td>IV</td><td>20</td><td>18</td><td>12</td></tr>
<tr><td>Total</td><td>90</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

6B14C MAT: Classical Mechanics

MODULE- I (18 Hours)

Introduction: Force, Rigid bodies, Types of forces, Law of reaction, Principle of transmissibility of force. (Chapter1: Sections 1.1 to 1.5 of text 1)

Forces acting at a point: Parallelogram of forces, Triangle of forces, Lami's theorem, Polygon of forces, Composition of forces, Expressions for the resultant, conditions of equilibrium, Oblique resolution, Worked examples, Systems of particles- Internal and external forces, Constraints- Smooth and rough bodies. (Chapter 3: Sections 3.1 to 3.7 of Text 1)

MODULE- II (18 Hours)

Moments, Parallel forces, couples: Moment of a force about a point, Theorem of moments, Moment of a force about a line, parallel forces, couples, Theorem of moments for parallel forces, Centre of parallel forces, Centre of gravity, Analytical formulae for centre of parallel forces, Couples, Equivalence of couples, Specification of a couple, Composition of couples. (Chapter 4: Sections 4.1 to 4.6 of text 1)

Coplanar forces: Reduction to a force at any point and a couple, Conditions of equilibrium, Analytical method, Worked examples. **(Chapter 5: Sections 5.1 to 5.3 of Text 1)**

MODULE- III (18 Hours)

Centres of gravity: Formulae, Rod, Parallelogram, triangle, quadrilateral, Tetrahedron, Cone, Centres of gravity by integration, Curves, Areas and Surface distributions, Volumes of revolution, Zone of the surface of a sphere. (Chapter 10: Sections 10.1 to 10.3 of Text 1)

Rectilinear motion, Kinetics: Newtonian mechanics, Force, Newton's first law, mass, Materail particle, Momentum, Measurement of force, Newton's second law, Force as a vector, Weight, C.G.S units, Impulse, Force-time curve, Work, Foot-pound, Power, Horse power, Erg, Energy, Kinetic and Potential, Formula for kinetic energy, Conservation of energy, Force-space curve, Efficiency, examples. (Chapter 4: Sections 4.1 to 4.4 of Text 2)

MODULE- I V (18 Hours)

Dynamical problems in two dimensions: Equivalence of force and mass $\times$ acceleration, Motion of projectiles, Range on an inclined plane, Geometrical construction, Resisting media, Example, resistance $\propto$ square of velocity, Principle of work, Examples. (Chapter 6: Sections 6.1 to 6.4 of Text 2)

Impulsive motion: Impulse and impulsive force, Equations of motion for impulsive forces, Impact of smooth spheres, Direct impact, Poisson's hypothesis, Oblique impact, Kinetic energy lost by impact , Generalization of Newton's rule, Examples of impulsive motion, Kinetic energy created by impulses, Examples. (Chapter 11: Sections 11.1 to 11.6 of Text 2)

Texts:

1. A. S. Ramsey, Statics, Cambridge University Press.
2. A. S. Ramsey, Dynamics, Cambridge University Press.

References:

1. F. Chorlton, A Text book of Dynamics, CBS Publishers and Distributors Pvt Ltd
2. Goldstein, Classical Mechanics, Pearson Education.
3. N.P Bali, Golden Dynamics, Laxmi Publications (P) Ltd.
4. Synge and Griffith, Principle of Mechanics, McGraw-Hill Book Company

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>Total</td><td>72</td><td>72</td><td>48</td><td>12</td><td>60</td></tr>
</table>

6B14D MAT: Programming in Python

Module I: Introduction to Python **(35 Hours)-**

General Information, Core Python, Functions and Modules, Mathematics Modules, Numarray Module, Scoping of variables, Writing and Running programs.
(Sections 1.1 to 1.7 of Text Book 2)

Module II: (25 Hours)

Data visualization – The Matplot lib Module, Plotting mathematical functions, Famous Curves, 2D plot using colors, Mesh grids, 3D Plots (Text Book 1)

Practicals: (10 Programmes) (30 Hours)

1. Solution of Ax=B using Doolittle method
2. Newton-Raphson's Method
3. Bisection Method
4. Method of false position
5. Trapezoidal rule of Numerical Integration
6. Simpson's Three Eighth rule of Numerical Integration
7. Euler's Modified Method to solve first order differential equation
8. Runge-Kutta Method of Order 4
9. Lagrange's Method for Interpolation
10. Taylor Series Method for initial value problems.

Texts:

1. B.P. Ajith Kumar, Python for Education – Learning Mathematics and Physics using Python
and writing them in Latex –. (Free download from www.iuac.res.in/phoenix)
2. J. Kiusalaas, Numerical Methods in Engineering with Python Cambridge University Press

References: Python Tutorial Release 2.6.1 by Guido Van Rossum, Fred L Great Junior (Free download from http// www.seipy.org/numpy_example_list

<table>
<tr><th colspan="2" rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="5">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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</table>

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External Evaluation of the Paper 6B14D MAT (Practical)

An external practical examination of two hours duration shall be conducted for 18 marks. For the practical examination student should do two questions out of three questions from the prescribed set of practical programmes given at the syllabus of the course. Students should keep a record book of the prescribed practical works done and the same may be valued by external examiners at the time of external practical examination.

Attending the practical examination is **mandatory** and no student (student who opt the paper as elective) shall be declared to have passed in the course 6B14D MAT without appearing for the practical examination concerned and without obtaining minimum 8 marks.

In the external practical examination, the marks are distributed as follows:

- Practical Record – 2 marks
- Writing source code of the programme in the answer sheet for the given question– 6marks
- Practical work done in the computer – 5 marks
- Correct output – 5 marks
- Total - 18 marks

External Evaluation of the Paper 6B14D MAT (Theory)

- Maximum Marks for each course - 30 Marks
- Duration of examination - 2 Hrs.

Section	Mark for each question	Number of Questions		Total Marks	
		Total	Required	Aggregate	Maximum
A	1	4	4	4	4
B	2	5	4	10	8
C	4	5	3	20	12
D	6	2	1	12	6
Total	----	16	12	46	30

Internal Evaluation of the Paper 6B14D MAT

Sl.No	% of Marks allotted	Theory		Practical	
		Components	**Marks allotted**	**Components**	**Marks allotted**
1	25	Attendance	2	Attendance	1
2	25	Assignment/ Seminar/Viva -voce	2	Practical Test	1
3	50	Test paper	3.5	Record & Lab Involvement	2.5
Total	**100**	--	7.5	-------	**4.5**

The total mark for the course 6B14D MAT is obtained by adding the marks obtained in external theory examination, internal examination and practical examination.

OPEN COURSES

Mathematics Departments can offer one of the following courses as Open Course

5D01 MAT: Business Mathematics
5D02 MAT: Astronomy
5D03 MAT: Quantitative Arithmetic and Reasoning
5D04 MAT: Linear Programming

Syllabus of Mathematics Open Courses

5D01 MAT: Business Mathematics

Module – I (18 Hours)

Functions, Limit and continuity: Constants and variables, functions, Graphs, Limit of a function, methods of finding limits definition, Differentiation- rules of differentiation, Parametric function logarithmic differentiation, Successive differentiation, Application to Business, Local maximum and local minimum, (*except concavity, convexity and points of inflexion*), solved examples. (Sections 3.1 to 3.10, 3.13, 3.15, 4.1, 4 .3, 4.4, 4.7,4.8, 5.2,5.3)

Module – II (18 Hours)

Integral Calculus: Rules of integration, Some standard results, Application to Business, Consumer's surplus, Producers surplus, Consumer's surplus under pure competition, Consumer's surplus under monopoly. Basic mathematics of finance, Nominal rate of interest, Effective rate of interest, Continuous compounding, Compound interest, Present valve, interest and discount, Rate of discount, Equation of value, Depreciation. (Sections 6.1 to 6.12, 7.1 to 7.5, 8.1 to 8.9)

Text: B. M. Aggarwal, Business Mathematics and Statistics, Ane Books Pvt. Ltd.

Reference: A. C. Chiang and K. Wainwright, Fundamental Methods of Mathematical Economics, 4th Edition, 2005.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	18	15	10	5	25	2
II	18	15	10			
Total	36	30	20	5	25	

5D 02 MAT: Astronomy

Module – I (12 Hours)

Sphere, Spherical Triangle, Polar triangle relation between them, Cosine formula, Sine Formula, Cotangent formula, Five parts formula, Half angels, Napirer's analogies, Spherical Co-ordinates.

Module – II (12 Hours)

Celestial spheres – Celestial sphere – Diurnal motion, Cardinal points, Hemispheres, Annual motion, Ecliptic, Obliquity, Celestial co-ordinate, Change in the co-ordinates of the sun in the course of the year, Sidereal time, latitude of a place, Relation between them, Hour angle of a body at rising and setting, Morning and evening star, Circumpolar star, Condition of circumpolar star, Diagram of the celestial sphere.

Module – III (12 Hours)

Earth, The zones of earth, Variation in the duration of day and night, Condition of perpetual day, Terrestrial latitude and longitude, Radius of earth – Foucault's Pendulum experiment.

Text: 1. S. Kumaravelu, Astronomy for degree classes.
2. J.V. Narlikar, Introduction to cosmology.

References:

1. B. Basu, An Introduction to Astrophysics.
2. S. Hofkings, A Brief History of Time.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	12	9	6	5	25	2
II	12	12	8			
III	12	9	6			
Total	36	30	20	5	25	

5D 03 MAT: Quantitative Arithmetic and Reasoning

Module – I (18 Hours)

Average, Problems on ages, Profit and loss, Ratio and proportion, Chain rule, Time and work. (Chapters 6, 8, 11, 12, 14, 15)

Module–II (18 Hours)

Time and distance, Problems on Trains, Boats and streams, Calendar, Clocks, Permutations and combinations, Heights and distances. (Chapters 17, 18, 19, 27, 28, 30, 34)

Text: R.S. Aggarwal, Quantitative Aptitude for Competitive Examinations, S. Chand Company Ltd, 7th Edition.

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>Total</td><td>36</td><td>30</td><td>20</td><td>5</td><td>25</td></tr>
</table>

5D 04 MAT: Linear Programming

Module – I (18 hours)

General linear programming problem – canonical and standard forms of L.P.P, Solutions and fundamental properties of solutions of LPP, Graphical solution method, Simplex method Duality in linear programming – General primal – dual pair, Formulating a dual problem. (Sections 3.2, 3.4, 3.5 ,4.1 to 4.3, 5.1 to 5.3 theorems without proof)

Module – II (18 hours)

General transportation problem, the transportation tables, Loops in transportation table solution of a transportation problem, Finding an initial basic feasible solution, Test for optimality, Degeneracy in transportation problem, Transportation algorithm (MODI method). (Sections 10.1, 10.2, 10.3, 10.5, 10.8, 10.9, 10.10, 10.11, 10.12 theorems without proof)

Mathematical formulation, the assignment method. (Sections 11.1 to 11.3 theorems without proof)

Text: K. Swarup, P.K. Gupta and M. Mohan, Operations Research, 12th Edition, Sulthan Chand and Sons.

References:

1. J. K. Sharma, Operations Research Theory and Applications. McMillan New Delhi.
2. G. Hadley, Linear Programming, Oxford & IBH Publishing Company, New Delhi.
3. H. A. Thaha, Operations Research, An Introduction, 8th Edition , Prentice Hall.

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<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
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<tr><td>I</td><td>18</td><td>13</td><td>9</td><td rowspan="2">5</td><td rowspan="2">25</td><td rowspan="3">2</td></tr>
<tr><td>II</td><td>18</td><td>17</td><td>11</td></tr>
<tr><td>Total</td><td>36</td><td>30</td><td>20</td><td>5</td><td>25</td></tr>
</table>

MATHEMATICS (COMPLEMENTARY COURSE)
SYLLABUS FOR PHYSICS

1C01MAT-PH: Mathematics for Physics -I

Module I : Differential Calculus and its Applications to Physics I (20 hrs)

Hyperbolic Functions, Derivation of parametrically defined functions, Logarithmic Differentiation. (Sections 4.7, 4.8 and 4.9 of Text 1)

Higher Order Derivatives-Calculation of the n^{th} derivative – some standard results-determination of n^{th} derivative of rational functions - the n^{th} derivatives of the products of the powers of sines and cosines - Leibniz's theorem on n^{th} derivative of a product of two functions (without proof) (Sections 5.1 to 5.5 of Text 1). Maclaurin's Theorem and Taylor's Theorem (without proofs) (Sections 6.1 and 6.2 of Text 1). Applications related to Physics of this module for assignment/seminar only (See the Text 2).

Module II : Differential Calculus and its Applications to Physics II (20 hrs)

Rolle's theorem, Lagrange's mean value theorem, Meaning of the sign of derivative, Cauchy's mean value theorem, higher derivatives (all theorems without proofs). [Sections 8.1, 8.2, 8.3, 8.5 and 8.6 (excluding 8.4 and 8.7) of Text 1]

Indeterminate forms, the indeterminate form 0/0, the indeterminate form ∞/∞, the indeterminate form $0\cdot\infty$, the indeterminate form $\infty - \infty$, the indeterminate forms 00, 1∞, $\infty 0$. (Sections 10.1 to 10.6 of Text 1)

Module III : Differential Calculus and its Applications to Physics III (22 hrs)

Partial Differentiation: Introduction, Functions of two variables, Neighbourhood of a point (a, b), continuity of a function of two variables, continuity at a point, limit of a function of two variables, homogeneous functions, Theorem on Total Differentials, Composite functions, Differentiation of Composite functions, Implicit Functions [Sections 11.1 to 11.10 of Text 1 (Proof of Theorem 11.10.1 omitted)]. Applications related to Physics of this module for assignment/seminar only (See the Reference 1).

Curvature and Evolutes: Introduction, Definition of Curvature, Length of arc as a function derivative of arc, Radius of curvature (Cartesian Equations), Centre of Curvature, Chord of Curvature, Evolutes and Involutes, Properties of the Evolute.
[Sections 14.1, 14.2, 14.3, 14.5, 14.6 and 14.7 (excluding 14.4 and 14.8) of Text 1]

Module IV : Geometry and its Applications to Physics (10 hrs)

Two Dimensional Geometry–Polar coordinates [Section 9.6 of Text 2]

Three Dimensional Geometry – Cylindrical and Spherical Coordinates.

[Section 10.7 of Text 2]. Applications related to Physics of this module for assignment/seminar only (See the Text 2).

Texts: 1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand, New Delhi.

2. Thomas and Finney, *Calculus and Analytic Geometry*, 9^{th} Edition, Pearson Education.

References:

1. E. Kreyszig, *Advanced Engineering Mathematics,* 9^{th} Edition, John Wiley & Sons..
2. Anton, Bivens, Davis, *Calculus*, 7^{th} edition, Wiley-India.
3. N.P. Bali and M. Goyal, *Engineering Mathematics*, 8^{th} Edition, Laxmi Publication.
4. B. S. Grewal, *Higher Engineering Mathematics,* 4^{0th} Edition, Khanna Publishers.

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<tr><td>I</td><td>20</td><td>18</td><td>12</td><td rowspan="4">10</td><td rowspan="4">50</td><td rowspan="5">3</td></tr>
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<tr><td>III</td><td>22</td><td>18</td><td>12</td></tr>
<tr><td>IV</td><td>10</td><td>9</td><td>6</td></tr>
<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

2C02 MAT-PH: Mathematics for Physics - II

Module I : Integral Calculus and its Applications to Physics - I (18 hrs)

Integration of Trigonometric Functions: Integration of $\sin^n x$ where *n* is a positive integer, Integration of $\cos^n x$ where *n* is a positive integer, Integration of $\sin^p x \cos^q x$ where p, q are positive integers, Integration of $\tan^n x$ and $\cot^n x$ where *n* is a positive integer, Integration of $\sec^n x$ where *n* is a positive integer. (Sections 4.1 to 4.5 of Text 1). Applications to Physics of this module for assignment/seminar only (See the Text 2).

Areas of Plane Regions - Area enclosed by two curves, quadrature of a hyperbola, Sectorial Area, Area bounded by a closed curve (formulae without proof).
(Sections 8.1, 8.2, 8.3, 8.4 of Text 1)

Rectification, lengths of plane curves: Introduction, Cartesian equations, Other expressions for lengths of arc, Intrinsic equation of a curve, rectification of ellipse (formulae without proof). [Sections 9.1, 9.2, 9.3, 9.4 and 9.5 of Text 1]

Module II : Integral Calculus and its Applications to Physics - II (18 hrs)

Volumes and Surfaces of Revolution: Axis of revolution, Volumes and surfaces of revolution, any axis of revolution, Area of the surface of the frustum of a cone, Surface of Revolution .[Sections 10.1, 10.2, 10.3, 10.4 and 10.5 (excluding proof) of Text 1]

Multiple Integrals: Multiple Integrals, Double integral, Applications of Double Integration, Change of order of integration, Change of the variable in a Multiple Integral, Triple integrals. (Sections 12.1 to 12.6 of Text 1). Applications related to Physics of this module for assignment/seminar only (See the Reference 1).

Module III : Matrices and Vectors (18 hrs)

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication (Excluding Motivation of Multiplication by Linear Transformations), Transposition, Special Matrices, Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Elementary Row Operations, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems - Existence, For Reference: Second and Third Order Determinants, Determinants – Cramer's Rule, Inverse of a Matrix: Gauss-Jordan Elimination, Uniqueness, Reduction formulae. (Sections 7.1 to 7.8 of Text 2)

Module IV: Linear Algebra (18 hrs)

Linear Algebra, Matrix Eigen Value Problems: Eigen values, Eigen vectors, Symmetric, Skew Symmetric and Orthogonal Matrices, Eigen bases, Diagonalization, Qudratic Forms (proofs of all theorems omitted). [Sections 8.1, 8.3 and 8.4 (except 8.2 and 8.5) of Text 2].

Cayley-Hamilton Theorem: Cayley-Hamilton Theorem (statement without proof) and its simple applications (finding $A^2, A^3, \cdots$ of a given square matrix A, finding A^{-1} of a non-singular matrix A) [Section Cayley-Hamilton Theorem in Chapter 23 of Text 3].

Texts:

1. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand and Company Ltd., New Delhi.
2. E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons, Inc.
3. Frank Ayres JR, *Theory of and Problems of Matrices*, Schaum's Outline Series, McGraw-Hill Book Company.

References:

1. Anton, Bivens, Davis, *Calculus*, 7th edition, Wiley-India.
2. N. P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.
3. S. S. Sastry, *Engineering Mathematics,* Volume II, 4th Edition, PHI.

<table>
<tr><th rowspan="2">Module</th><th rowspan="2">Teaching Hours</th><th colspan="2">External Examination</th><th rowspan="2">Internal Mark</th><th rowspan="2">Total Mark</th><th rowspan="2">Credit</th></tr>
<tr><th>Aggregate Mark</th><th>Maximum Mark</th></tr>
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<tr><td>II</td><td>18</td><td>15</td><td>10</td></tr>
<tr><td>III</td><td>18</td><td>15</td><td>10</td></tr>
<tr><td>IV</td><td>18</td><td>15</td><td>10</td></tr>
<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

3C03MAT-PH: Mathematics for Physics - III

Module I : First Order Ordinary Differential Equations (20 hrs)

Basic concepts, Modeling, and ideas, Geometrical meaning of $y' = f(x, y)$. Direction Fields, Separable ODEs, Modeling, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation, Population Dynamics, Orthogonal Trajectories, Existence and Uniqueness of Solution (proof of theorem omitted). (Chapter 1 Sections 1.1 to 1.7).

Module II: Second Order Ordinary Differential Equations (20 hrs)

Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Nonhomogeneous ODEs, Solution by variation of Parameters.(Sections 2.1 to 2.10 *except* 2.4, 2.8 and 2.9).

Module III: Laplace Transforms and its Applications to Physics (20 hrs)

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, *s*-Shifting, Transforms of Derivatives and Integrals, ODEs, Unit step Function, *t*- Shifting, Short Impulses, Dirac's Delta Function, Partial Fractions, Convolution, Integral Equations, Differentiation and integration of Transforms, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms. [Chapter 6 Sections 6.1 to 6.9 (Proofs omitted)]. Applications related to Physics of this module for assignment/seminar only (See the relevant projects in the Text).

Module IV: Fourier Series, Partial Differential Equations and Applications (30 hrs)

Fourier Series : Fourier series, Functions of any period $p = 2L$, Even and Odd functions, Half-range Expansions. [Chapter 11 Sections 11.1 to 11.3 (Proofs omitted)]

Partial differential Equations: Basic Concepts, Modeling, Vibrating String, Wave Equation, Solution by Separating Variables, Use of Fourier Series, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series. [Chapter 12 sections 12.1 to 12.5 (*Excluding* steady two dimensional heat problems and Laplace equation of 12.5)]. Applications related to Physics of this module for assignment/seminar only (See the relevant projects in the Text).

Text : E. Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons.

References:
1. S.S. Sastry, Engineering Mathematics, Volume II, 4th Edition, PHI.
2. M. R. Spiegel, Advanced Calculus, Schaum's Outline Series.
3. M. R. Spiegel, Laplace Transforms, Schaum's Outline Series.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	15	10	10	50	3
II	20	14	9			
III	20	13	9			
IV	30	18	12			
Total	90	60	40	10	50	

4C04 MAT-PH: Mathematics for Physics - IV

Module I : Vector Differential Calculus and its Applications to Physics (25 hrs)

Vector and scalar functions and Fields, Derivatives, Curves, Arc Length, Curvature, Torsion, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field. [Sections 9.4 to 9.9 (Excluding 9.6) of Text 1]. Applications related to Physics of this module for assignment/seminar only (See the relevant projects in the Text 1).

Module II : Vector Integral Calculus and its Applications to Physics (25 hrs)

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane (without proof), Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem (without proofs).[Chapter 10 Sections 10.1 to 10.9 (Excluding 10.3 and 10.8) of Text 1]. Applications related to Physics of this module for assignment/seminar only (See the relevant projects in the Text 1).

Module III Numerical Analysis – I (25 hrs)

Solution of Algebraic and Transcendental Equation : Bisection Method, Method of false position, Newton-Raphson Method (Chapter 2 Sections 2.2, 2.3 and 2.5 of Text 2)

Finite Differences and Interpolation: Forward differences, Backward differences. Newton's formulae for intrapolation, Langrange's interpolation formula, Divided differences and their properties.(Sections 3.3.1, 3.3.2, 3.6, 3.9.1 and 3.10 of Text 2)

Numerical Differentiation and Integration: Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule (Chapter 5 Sections 5.2, 5.4, 5.4.1 and 5.4.2 of Text 2)

Module IV Numerical Analysis – II (15 hrs)

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method. (Sections 7.1 to 7.4, 7.4.2 and 7.5 of Text 2)

Texts:
1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, 4th Edition, PHI.

References:

1. H. F. Davis & Arthur David Snider, *Introduction to Vector Analysis*, 6th Edition, Universal Book Stall, New Delhi.
2. M. R. Spiegel, *Vector Analysis*, Schaum's Outline Series, Asian Student edition.
3. S. S. Rao, *Numerical Methods of Scientists and Engineers*, 3rd Edition, PHI

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	25	15	10	10	50	3
II	25	15	10			
III	25	18	12			
IV	15	12	8			
Total	90	60	40	10	50	

MATHEMATICS (COMPLEMENTARY COURSE)
SYLLABUS FOR CHEMISTRY

1C01MAT-CH: Mathematics for Chemistry -I

Module I : Differential Calculus and its Applications to Chemistry (20 hrs)

Hyperbolic Functions, Derivation of parametrically defined functions, Logarithmic Differentiation. (Sections 4.7, 4.8 and 4.9 of Text 1)

Higher Order Derivatives-Calculation of the n^{th} derivative – some standard results-determination of n^{th} derivative of rational functions - the n^{th} derivatives of the products of the powers of sines and cosines - Leibniz's theorem on n^{th} derivative of a product of two functions (without proof) (Sections 5.1 to 5.5 of Text 1). Maclaurin's Theorem and Taylor's Theorem (without proofs) (Sections 6.1 and 6.2 of Text 1). Applications related to chemistry of this module for assignment/seminar only.

Module II : Differential Calculus and its Applications to Chemistry II (20 hrs)

Rolle's theorem, Lagrange's mean value theorem, Meaning of the sign of derivative, Cauchy's mean value theorem, higher derivatives (all theorems without proofs). [Sections 8.1, 8.2, 8.3, 8.5 and 8.6 (excluding 8.4 and 8.7) of Text 1]

Indeterminate forms, the indeterminate form 0/0, the indeterminate form ∞/∞, the indeterminate form $0 \cdot \infty$, the indeterminate form $\infty - \infty$, the indeterminate forms 00, 1∞, ∞0 . (Sections 10.1 to 10.6 of Text 1)

Module III : Differential Calculus and its Applications to Chemistry III (22 hrs)

Partial Differentiation: Introduction, Functions of two variables, Neighbourhood of a point (a, b), continuity of a function of two variables, continuity at a point, limit of a function of two variables, homogeneous functions, Theorem on Total Differentials, Composite functions, Differentiation of Composite functions, Implicit Functions [Sections 11.1 to 11.10 of Text 1 (Proof of Theorem 11.10.1 omitted)]. Applications related to Chemistry of this module for assignment/seminar only.

Curvature and Evolutes: Introduction, Definition of Curvature, Length of arc as a function derivative of arc, Radius of curvature (Cartesian Equations), Centre of Curvature, Chord of Curvature, Evolutes and Involutes, Properties of the Evolute.
[Sections 14.1, 14.2, 14.3, 14.5, 14.6 and 14.7 (excluding 14.4 and 14.8) of Text 1]

Module IV : Geometry and its Applications to Chemistry (10 hrs)

Two Dimensional Geometry–Polar coordinates [Section 9.6 of Text 2]

Three Dimensional Geometry – Cylindrical and Spherical Coordinates.

[Section 10.7 of Text 2]. Applications related to Chemistry of this module for assignment/seminar only.

Texts: 1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand, New Delhi.

2. Thomas and Finney, *Calculus and Analytic Geometry*, 9th Edition, Pearson Education.

References:

1 E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons..

2 Anton, Bivens, Davis, *Calculus*, 7th edition, Wiley-India.

3. N.P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.

4. B. S. Grewal, *Higher Engineering Mathematics,* 40th Edition, Khanna Publishers.

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<tr><td>III</td><td>22</td><td>18</td><td>12</td></tr>
<tr><td>IV</td><td>10</td><td>9</td><td>6</td></tr>
<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
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2C02 MAT-CH: Mathematics for Chemistry - II

Module I : Integral Calculus and its Applications to Chemistry - I (18 hrs)

Integration of Trigonometric Functions: Integration of $\sin^n x$ where *n* is a positive integer, Integration of $\cos^n x$ where *n* is a positive integer, Integration of $\sin^p x \cos^q x$ where p, q are positive integers, Integration of $\tan^n x$ and $\cot^n x$ where *n* is a positive integer, Integration of $\sec^n x$ where *n* is a positive integer. (Sections 4.1 to 4.5 of Text 1). Applications to Chemistry of this module for assignment/seminar only.

Areas of Plane Regions - Area enclosed by two curves, quadrature of a hyperbola, Sectorial Area, Area bounded by a closed curve (formulae without proof).
(Sections 8.1, 8.2, 8.3, 8.4 of Text 1)

Rectification, lengths of plane curves: Introduction, Cartesian equations, Other expressions for lengths of arc, Intrinsic equation of a curve, rectification of ellipse (formulae without proof). [Sections 9.1, 9.2, 9.3, 9.4 and 9.5 of Text 1]

Module II : Integral Calculus and its Applications to Chemistry - II (18 hrs)

Volumes and Surfaces of Revolution: Axis of revolution, Volumes and surfaces of revolution, any axis of revolution, Area of the surface of the frustum of a cone, Surface of Revolution .[Sections 10.1, 10.2, 10.3, 10.4 and 10.5 (excluding proof) of Text 1]

Multiple Integrals: Multiple Integrals, Double integral, Applications of Double Integration, Change of order of integration, Change of the variable in a Multiple Integral, Triple integrals. (Sections 12.1 to 12.6 of Text 1). Applications related to Chemistry of this module for assignment/seminar only.

Module III : Matrices and Vectors (18 hrs)

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication (Excluding Motivation of Multiplication by Linear Transformations), Transposition, Special Matrices, Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Elementary Row Operations, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems - Existence, For Reference: Second and Third Order Determinants, Determinants – Cramer's Rule, Inverse of a Matrix: Gauss-Jordan Elimination, Uniqueness, Reduction formulae. (Sections 7.1 to 7.8 of Text 2)

Module IV: Linear Algebra (18 hrs)

Linear Algebra, Matrix Eigen Value Problems: Eigen values, Eigen vectors, Symmetric, Skew Symmetric and Orthogonal Matrices, Eigen bases, Diagonalization, Qudratic Forms (proofs of all theorems omitted). [Sections 8.1, 8.3 and 8.4 (except 8.2 and 8.5) of Text 2].

Cayley-Hamilton Theorem: Cayley-Hamilton Theorem (statement without proof) and its simple applications (finding $A^2, A^3, \cdots$ of a given square matrix A, finding A^{-1} of a non-singular matrix A) [Section Cayley-Hamilton Theorem in Chapter 23 of Text 3].

Texts:

1. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand and Company Ltd., New Delhi.
2. E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons, Inc.
3. Frank Ayres JR, *Theory of and Problems of Matrices*, Schaum's Outline Series, McGraw-Hill Book Company.

References:

1. Anton, Bivens, Davis, *Calculus*, 7th Edition, Wiley-India.
2. N. P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.
3. S. S. Sastry, *Engineering Mathematics,* Volume II, 4th Edition, PHI.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

3C03MAT-CH: Mathematics for Chemistry - III

Module I : First Order Ordinary Differential Equations (20 hrs)

Basic concepts, Modeling, and ideas, Geometrical meaning of $y' = f(x, y)$. Direction Fields, Separable ODEs, Modeling, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation, Population Dynamics, Orthogonal Trajectories, Existence and Uniqueness of Solution (proof of theorem omitted). (Chapter 1 Sections 1.1 to 1.7).

Module II: Second Order Ordinary Differential Equations (20 hrs)

Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Nonhomogeneous ODEs, Solution by variation of Parameters.(Sections 2.1 to 2.10 *except* 2.4, 2.8 and 2.9).

Module III: Laplace Transforms and its Applications to Chemistry (20 hrs)

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, *s*-Shifting, Transforms of Derivatives and Integrals, ODEs, Unit step Function, *t*- Shifting, Short Impulses, Dirac's Delta Function, Partial Fractions, Convolution, Integral Equations, Differentiation and integration of Transforms, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms. [Chapter 6 Sections 6.1 to 6.9 (Proofs omitted)]. Applications related to chemistry of this module for assignment/seminar only (See the relevant projects in the Text).

Module IV: Fourier Series, Partial Differential Equations and Applications (30 hrs)

Fourier Series : Fourier series, Functions of any period $p = 2L$, Even and Odd functions, Half-range Expansions. [Chapter 11 Sections 11.1 to 11.3 (Proofs omitted)]

Partial differential Equations: Basic Concepts, Modeling, Vibrating String, Wave Equation, Solution by Separating Variables, Use of Fourier Series, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series. [Chapter 12 sections 12.1 to 12.5 (*Excluding* steady two dimensional heat problems and Laplace equation of 12.5)]. Applications related to Chemistry of this module for assignment/seminar only (See the relevant projects in the Text).

Text : E. Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons.

References: 1. S.S. Sastry, Engineering Mathematics, Volume II, 4th Edition, PHI.
2. M. R. Spiegel, Advanced Calculus, Schaum's Outline Series.
3. M. R. Spiegel, Laplace Transforms, Schaum's Outline Series.

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<tr><td>III</td><td>20</td><td>13</td><td>9</td></tr>
<tr><td>IV</td><td>30</td><td>18</td><td>12</td></tr>
<tr><td>Total</td><td>90</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

4C04 MAT-CH: Mathematics for Chemistry - IV

Module I : Vector Differential Calculus and its Applications to Chemistry (25 hrs)

Vector and scalar functions and Fields, Derivatives, Curves, Arc Length, Curvature, Torsion, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field. [Chapter 9 Sections 9.4 to 9.9 (Excluding 9.6) of Text 1]. Applications related to Chemistry of this module for assignment/seminar only.

Module II : Vector Integral Calculus and its Applications to Chemistry (25 hrs)

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane (without proof), Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem (without proofs).[Chapter 10 Sections 10.1 to 10.9 (Excluding 10.3 and 10.8) of Text 1]. Applications related to Chemistry of this module for assignment/seminar only.

Module III Numerical Analysis – I (25 hrs)

Solution of Algebraic and Transcendental Equation: Bisection Method, Method of false position, Newton-Raphson Method (Chapter 2 Sections 2.2, 2.3 and 2.5 of Text 2)

Finite Differences : Forward differences, Backward differences (Chapter 3 Sections 3.3.1 and 3.3.2 of Text 2)

Interpolation: Newton's formulae for intrapolation, Langrange's interpolation formula, Divided differences and their properties.(Chapter 3 Sections 3.6, 3.9.1 and 3.10 of Text 2)

Numerical Differentiation and Integration: Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule (Chapter 5 Sections 5.2, 5.4, 5.4.1 and 5.4.2 of Text 2)

Module IV Numerical Analysis – II (15 hrs)

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method. (Sections 7.1 to 7.4, 7.4.2 and 7.5 of Text 2)

Texts:
1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. S. S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

References:

1. H. F. Davis & Arthur David Snider, *Introduction to Vector Analysis*, 6^{th} Edition, Universal Book Stall, New Delhi.
2. M. R. Spiegel, *Vector Analysis*, Schaum's Outline Series, Asian Student Edition.
3. S. Sankara Rao, *Numerical Methods of Scientists and Engineers*, 3^{rd} Edition, PHI.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	25	15	10	10	50	3
II	25	15	10			
III	25	18	12			
IV	15	12	8			
Total	90	60	40	10	50	

MATHEMATICS (COMPLEMENTARY COURSE) SYLLABUS FOR STATISTICS

1C01MAT-ST: Mathematics for Statistics-I

Module I : Differential Calculus and its Applications to Statistics (20 hrs)

Hyperbolic Functions, Derivation of parametrically defined functions, Logarithmic Differentiation. (Sections 4.7, 4.8 and 4.9 of Text 1)

Higher Order Derivatives-Calculation of the n^{th} derivative – some standard results-determination of n^{th} derivative of rational functions - the n^{th} derivatives of the products of the powers of sines and cosines - Leibniz's theorem on n^{th} derivative of a product of two functions (without proof) (Sections 5.1 to 5.5 of Text 1). Maclaurin's Theorem and Taylor's Theorem (without proofs) (Sections 6.1 and 6.2 of Text 1). Applications related to Statistics of this module for assignment/seminar only.

Module II : Differential Calculus and its Applications to Statistics II (20 hrs)

Rolle's theorem, Lagrange's mean value theorem, Meaning of the sign of derivative, Cauchy's mean value theorem, higher derivatives (all theorems without proofs). [Sections 8.1, 8.2, 8.3, 8.5 and 8.6 (excluding 8.4 and 8.7) of Text 1]

Indeterminate forms, the indeterminate form 0/0, the indeterminate form ∞/∞, the indeterminate form $0 \cdot \infty$, the indeterminate form ∞ – ∞, the indeterminate forms 00, 1∞, ∞0 . (Sections 10.1 to 10.6 of Text 1)

Module III : Differential Calculus and its Applications to Statistics III (22 hrs)

Partial Differentiation: Introduction, Functions of two variables, Neighbourhood of a point (a, b), continuity of a function of two variables, continuity at a point, limit of a function of two variables, homogeneous functions, Theorem on Total Differentials, Composite functions, Differentiation of Composite functions, Implicit Functions [Sections 11.1 to 11.10 of Text 1 (Proof of Theorem 11.10.1 omitted)]. Applications related to Statistics of this module for assignment/seminar only.

Curvature and Evolutes: Introduction, Definition of Curvature, Length of arc as a function derivative of arc, Radius of curvature (Cartesian Equations), Centre of Curvature, Chord of Curvature, Evolutes and Involutes, Properties of the Evolute.

[Sections 14.1, 14.2, 14.3, 14.5, 14.6 and 14.7 (excluding 14.4 and 14.8) of Text 1]

Module IV : Geometry and its Applications to Statistics (10 hrs)

Two Dimensional Geometry–Polar coordinates [Section 9.6 of Text 2]

Three Dimensional Geometry – Cylindrical and Spherical Coordinates.

[Section 10.7 of Text 2]. Applications related to Statistics of this module for assignment/seminar only.

Texts: 1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand, New Delhi.

2. Thomas and Finney, *Calculus and Analytic Geometry*, 9^{th} Edition, Pearson Education.

References:

1 E. Kreyszig, *Advanced Engineering Mathematics,* 9^{th} Edition, John Wiley & Sons..
2. Anton, Bivens, Davis, *Calculus*, 7^{th} edition, Wiley-India.
3. N.P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8^{th} Edition, Laxmi Publication.
4. B. S. Grewal, *Higher Engineering Mathematics,* 40^{th} Edition, Khanna Publishers.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

2C02 MAT-ST: Mathematics for Statistics - II

Module I : Integral Calculus and its Applications to Statistics - I (18 hrs)

Integration of Trigonometric Functions: Integration of $\sin^n x$ where *n* is a positive integer, Integration of $\cos^n x$ where *n* is a positive integer, Integration of $\sin^p x \cos^q x$ where p, q are positive integers, Integration of $\tan^n x$ and $\cot^n x$ where *n* is a positive integer, Integration of $\sec^n x$ where *n* is a positive integer. (Sections 4.1 to 4.5 of Text 1). Applications related to Statistics of this module only for assignment/seminar.

Areas of Plane Regions - Area enclosed by two curves, quadrature of a hyperbola, Sectorial Area, Area bounded by a closed curve (formulae without proof). (Sections 8.1, 8.2, 8.3, 8.4 of Text 1)

Rectification, lengths of plane curves: Introduction, Cartesian equations, Other expressions for lengths of arc, Intrinsic equation of a curve, rectification of ellipse (formulae without proof). [Sections 9.1, 9.2, 9.3, 9.4 and 9.5 of Text 1]

Module II : Integral Calculus and its Applications to Statistics - II (18 hrs)

Volumes and Surfaces of Revolution: Axis of revolution, Volumes and surfaces of revolution, any axis of revolution, Area of the surface of the frustum of a cone, Surface of Revolution .[Sections 10.1, 10.2, 10.3, 10.4 and 10.5 (excluding proof) of Text 1]

Multiple Integrals: Multiple Integrals, Double integral, Applications of Double Integration, Change of order of integration, Change of the variable in a Multiple Integral, Triple integrals. (Sections 12.1 to 12.6 of Text 1). Applications related to Statistics of this module for assignment/seminar only.

Module III : Matrices and Vectors (18 hrs)

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication (Excluding Motivation of Multiplication by Linear Transformations), Transposition, Special Matrices, Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Elementary Row Operations, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems - Existence, For Reference: Second and Third Order Determinants, Determinants – Cramer's Rule, Inverse of a Matrix: Gauss-Jordan Elimination, Uniqueness, Reduction formulae. (Sections 7.1 to 7.8 of Text 2)

Module IV: Linear Algebra (18 hrs)

Linear Algebra, Matrix Eigen Value Problems: Eigen values, Eigen vectors, Symmetric, Skew Symmetric and Orthogonal Matrices, Eigen bases, Diagonalization, Qudratic Forms (proofs of all theorems omitted). [Sections 8.1, 8.3 and 8.4 (Except 8.2 and 8.5) of Text 2].

Cayley-Hamilton Theorem: Cayley-Hamilton Theorem (statement without proof) and its simple applications (finding $A^2, A^3, \cdots$ of a given square matrix A, finding A^{-1} of a non-singular matrix A) [Section Cayley-Hamilton Theorem in Chapter 23 of Text 3].

Texts:

1. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand and Company Ltd., New Delhi.
2. E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons, Inc.
3. Frank Ayres JR, *Theory of and Problems of Matrices*, Schaum's Outline Series, McGraw-Hill Book Company.

References:

1. Anton, Bivens, Davis, *Calculus*, 7th Edition, Wiley-India.
2. N. P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.
3. S. S. Sastry, *Engineering Mathematics,* Volume II, 4th Edition, PHI.

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<tr><td>IV</td><td>18</td><td>15</td><td>10</td></tr>
<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

3C03MAT-ST: Mathematics for Statistics - III

Module I : First Order Ordinary Differential Equations (20 hrs)

Basic concepts, Modeling, and ideas, Geometrical meaning of $y' = f(x, y)$. Direction Fields, Separable ODEs, Modeling, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation, Population Dynamics, Orthogonal Trajectories, Existence and Uniqueness of Solution (proof of theorem omitted). (Chapter 1 Sections 1.1 to 1.7).

Module II: Second Order Ordinary Differential Equations (20 hrs)

Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Nonhomogeneous ODEs, Solution by variation of Parameters.(Sections 2.1 to 2.10 *except* 2.4, 2.8 and 2.9).

Module III: Laplace Transforms and its Applications to Statistics (20 hrs)

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, *s*-Shifting, Transforms of Derivatives and Integrals, ODEs, Unit step Function, *t*- Shifting, Short Impulses, Dirac's Delta Function, Partial Fractions, Convolution, Integral Equations, Differentiation and integration of Transforms, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms. [Chapter 6 Sections 6.1 to 6.9 (Proofs omitted)]. Applications related to Statistics of this module for assignment/seminar only (See the relevant projects in the Text).

Module IV: Fourier Series, Partial Differential Equations and Applications (30 hrs)

Fourier Series : Fourier series, Functions of any period $p = 2L$, Even and Odd functions, Half-range Expansions. [Chapter 11 Sections 11.1 to 11.3 (Proofs omitted)]

Partial differential Equations: Basic Concepts, Modeling, Vibrating String, Wave Equation, Solution by Separating Variables, Use of Fourier Series, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series. [Chapter 12 sections 12.1 to 12.5 (*Excluding* steady two dimensional heat problems and Laplace equation of 12.5)]. Applications related to Statistics of this module for assignment/seminar only (See the relevant projects in the Text).

Text : E. Kreyszig, *Advanced Engineering Mathematics*, 9th Edition, John Wiley & Sons.

References: 1. S.S. Sastry, Engineering Mathematics, Volume II, 4th Edition, PHI.

2. M. R. Spiegel, Advanced Calculus, Schaum's Outline Series.
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<tr><td>IV</td><td>30</td><td>18</td><td>12</td></tr>
<tr><td>Total</td><td>90</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

4C04 MAT-ST: Mathematics for Statistics - IV

Module I : Vector Differential Calculus and its Applications to Statistics (25 hrs)

Vector and scalar functions and Fields, Derivatives, Curves, Arc Length, Curvature, Torsion, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field. [Chapter 9 Sections 9.4 to 9.9 (Excluding 9.6) of Text 1]. Applications related to Statistics of this module for assignment/seminar only.

Module II : Vector Integral Calculus and its Applications to Statistics (25 hrs)

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane (without proof), Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem (without proofs).[Chapter 10 Sections 10.1 to 10.9 (Excluding 10.3 and 10.8) of Text 1]. Applications related to Statistics of this module for assignment/seminar only.

Module III Numerical Analysis – I (25 hrs)

Solution of Algebraic and Transcendental Equation: Bisection Method, Method of false position, Newton-Raphson Method (Chapter 2 Sections 2.2, 2.3 and 2.5 of Text 2)

Finite Differences : Forward differences, Backward differences (Chapter 3 Sections 3.3.1 and 3.3.2 of Text 2)

Interpolation: Newton's formulae for intrapolation, Langrange's interpolation formula, Divided differences and their properties.(Chapter 3 Sections 3.6, 3.9.1 and 3.10 of Text 2)

Numerical Differentiation and Integration: Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule (Chapter 5 Sections 5.2, 5.4, 5.4.1 and 5.4.2 of Text 2)

Module IV Numerical Analysis – II (15 hrs)

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method. (Sections 7.1 to 7.4, 7.4.2 and 7.5 of Text 2)

Texts:
1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

References:

1. H. F. Davis & Arthur David Snider, *Introduction to Vector Analysis*, 6th Edition, Universal Book Stall, New Delhi.
2. M. R. Spiegel, *Vector Analysis*, Schaum's Outline Series, Asian Student Edition.
3. S. Sankara Rao, *Numerical Methods of Scientists and Engineers*, 3rd Edition, PHI.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	25	15	10	10	50	3
II	25	15	10			
III	25	18	12			
IV	15	12	8			
Total	90	60	40	10	50	

MATHEMATICS (COMPLEMENTARY COURSE)
SYLLABUS FOR COMPUTER SCIENCE

1C01MAT-CS: Mathematics for Computer Science -I

Module I : Differential Calculus and its Applications to Computer Science I (20 hrs)

Hyperbolic Functions, Derivation of parametrically defined functions, Logarithmic Differentiation. (Sections 4.7, 4.8 and 4.9 of Text 1)

Higher Order Derivatives-Calculation of the n^{th} derivative – some standard results-determination of n^{th} derivative of rational functions - the n^{th} derivatives of the products of the powers of sines and cosines - Leibniz's theorem on n^{th} derivative of a product of two functions (without proof) (Sections 5.1 to 5.5 of Text 1). Maclaurin's Theorem and Taylor's Theorem (without proofs) (Sections 6.1 and 6.2 of Text 1). Applications related to Computer Science of this module for assignment/seminar only (See the Rerence 1).

Module II : Differential Calculus and its Applications to Computer Science II (20 hrs)

Rolle's theorem, Lagrange's mean value theorem, Meaning of the sign of derivative, Cauchy's mean value theorem, higher derivatives (all theorems without proofs). [Sections 8.1, 8.2, 8.3, 8.5 and 8.6 (excluding 8.4 and 8.7) of Text 1]

Indeterminate forms, the indeterminate form 0/0, the indeterminate form ∞/∞, the indeterminate form $0\cdot\infty$, the indeterminate form ∞ – ∞, the indeterminate forms 00, 1∞, ∞0 . (Sections 10.1 to 10.6 of Text 1)

Module III : Differential Calculus & its Applications to Computer Science III (22 hrs)

Partial Differentiation: Introduction, Functions of two variables, Neighbourhood of a point (a, b), continuity of a function of two variables, continuity at a point, limit of a function of two variables, homogeneous functions, Theorem on Total Differentials, Composite functions, Differentiation of Composite functions, Implicit Functions [Sections 11.1 to 11.10 of Text 1 (Proof of Theorem 11.10.1 omitted)]. Applications related to Computer Science of this module for assignment/seminar only (See the Reference 1).

Curvature and Evolutes: Introduction, Definition of Curvature, Length of arc as a function derivative of arc, Radius of curvature (Cartesian Equations), Centre of Curvature, Chord of Curvature, Evolutes and Involutes, Properties of the Evolute.
[Sections 14.1, 14.2, 14.3, 14.5, 14.6 and 14.7 (excluding 14.4 and 14.8) of Text 1]

Module IV : Geometry and its Applications to Computer Science (10 hrs)

Two Dimensional Geometry–Polar coordinates [Section 9.6 of Text 2]

Three Dimensional Geometry – Cylindrical and Spherical Coordinates.
[Section 10.7 of Text 2]. Applications related to Computer Science of this module for assignment/seminar only (See the Text 2).

Texts: 1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand, New Delhi.
2. Thomas and Finney, *Calculus and Analytic Geometry*, 9^{th} Edition, Pearson Education.

References:

1. E. Kreyszig, *Advanced Engineering Mathematics,* 9^{th} Edition, John Wiley & Sons..
2. Anton, Bivens, Davis, *Calculus*, 7^{th} edition, Wiley-India.
3. N.P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8^{th} Edition, Laxmi Publication.
4. B. S. Grewal, *Higher Engineering Mathematics,* 4^{0th} Edition, Khanna Publishers.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

2C02 MAT-CS: Mathematics for Computer Science - II

Module I : Integral Calculus and its Applications to Computer Science - I (18 hrs)

Integration of Trigonometric Functions: Integration of $\sin^n x$ where *n* is a positive integer, Integration of $\cos^n x$ where *n* is a positive integer, Integration of $\sin^p x \cos^q x$ where p, q are positive integers, Integration of $\tan^n x$ and $\cot^n x$ where *n* is a positive integer, Integration of $\sec^n x$ where *n* is a positive integer. (Sections 4.1 to 4.5 of Text 1). Applications to Computer Science of this module for assignment/seminar only (See the Text 2).

Areas of Plane Regions - Area enclosed by two curves, quadrature of a hyperbola, Sectorial Area, Area bounded by a closed curve (formulae without proof).
(Sections 8.1, 8.2, 8.3, 8.4 of Text 1)

Rectification, lengths of plane curves: Introduction, Cartesian equations, Other expressions for lengths of arc, Intrinsic equation of a curve, rectification of ellipse (formulae without proof). [Sections 9.1, 9.2, 9.3, 9.4 and 9.5 of Text 1]

Module II : Integral Calculus and its Applications to Computer Science - II (18 hrs)

Volumes and Surfaces of Revolution: Axis of revolution, Volumes and surfaces of revolution, any axis of revolution, Area of the surface of the frustum of a cone, Surface of Revolution .[Sections 10.1, 10.2, 10.3, 10.4 and 10.5 (excluding proof) of Text 1]

Multiple Integrals: Multiple Integrals, Double integral, Applications of Double Integration, Change of order of integration, Change of the variable in a Multiple Integral, Triple integrals. (Sections 12.1 to 12.6 of Text 1). Applications related to Computer Science of this module for assignment/seminar only (See the Reference 1).

Module III : Matrices and Vectors (18 hrs)

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication (Excluding Motivation of Multiplication by Linear Transformations), Transposition, Special Matrices, Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Elementary Row Operations, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems - Existence, For Reference: Second and Third Order Determinants, Determinants – Cramer's Rule, Inverse of a Matrix: Gauss-Jordan Elimination, Uniqueness, Reduction formulae. (Sections 7.1 to 7.8 of Text 2)

Module IV: Linear Algebra (18 hrs)

Linear Algebra, Matrix Eigen Value Problems: Eigen values, Eigen vectors, Symmetric, Skew Symmetric and Orthogonal Matrices, Eigen bases, Diagonalization, Qudratic Forms (proofs of all theorems omitted). [Sections 8.1, 8.3 and 8.4 (except 8.2 and 8.5) of Text 2].

Cayley-Hamilton Theorem: Cayley-Hamilton Theorem (statement without proof) and its simple applications (finding $A^2, A^3, \cdots$ of a given square matrix A, finding A^{-1} of a non-singular matrix A) [Section Cayley-Hamilton Theorem in Chapter 23 of Text 3].

Texts:

1. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand and Company Ltd., New Delhi.
2. E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons, Inc.
3. Frank Ayres JR, *Theory of and Problems of Matrices*, Schaum's Outline Series, McGraw-Hill Book Company.

References:

1. Anton, Bivens, Davis, *Calculus*, 7th edition, Wiley-India.
2. N. P. Bali, Dr. Manish Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.
3. S. S. Sastry, *Engineering Mathematics,* Volume II, 4th Edition, PHI.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

3C03 MAT-CS: Mathematics for Computer Science - III

Module I : First Order Ordinary Differential Equations (20 hrs)

Basic concepts, Modeling, and ideas, Geometrical meaning of $y' = f(x, y)$. Direction Fields, Separable ODEs, Modeling, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation, Population Dynamics, Orthogonal Trajectories, Existence and Uniqueness of Solution (proof of theorem omitted). (Chapter 1 Sections 1.1 to 1.7).

Module II: Second Order Ordinary Differential Equations (20 hrs)

Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Nonhomogeneous ODEs, Solution by variation of Parameters.(Sections 2.1 to 2.10 *except* 2.4, 2.8 and 2.9).

Module III: Laplace Transforms and its Applications to Computer Science (20 hrs)

Laplace Transforms: Laplace Transform, Inverse Transform, Linearity, *s*-Shifting, Transforms of Derivatives and Integrals, ODEs, Unit step Function, *t*- Shifting, Short Impulses, Dirac's Delta Function, Partial Fractions, Convolution, Integral Equations, Differentiation and integration of Transforms, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms. [Chapter 6 Sections 6.1 to 6.9 (Proofs omitted)]. Applications related to Computer Science of this module for assignment/seminar only (See the relevant projects in the Text).

Module IV: Fourier Series, Partial Differential Equations and Applications (30 hrs)

Fourier Series : Fourier series, Functions of any period $p = 2L$, Even and Odd functions, Half-range Expansions. [Chapter 11 Sections 11.1 to 11.3 (Proofs omitted)]

Partial differential Equations: Basic Concepts, Modeling, Vibrating String, Wave Equation, Solution by Separating Variables, Use of Fourier Series, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series. [Chapter 12 sections 12.1 to 12.5 (*Excluding* steady two dimensional heat problems and Laplace equation of 12.5)]. Applications related to Computer Science of this module for assignment/seminar only (See the relevant projects in the Text).

Text : E. Kreyszig, *Advanced Engineering Mathematics*, 9^{th} Edition, John Wiley & Sons.

References: 1. S.S. Sastry, Engineering Mathematics, Volume II, 4^{th} Edition, PHI.

2. M. R. Spiegel, Advanced Calculus, Schaum's Outline Series.
3. M. R. Spiegel, Laplace Transforms, Schaum's Outline Series.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	15	10	10	50	3
II	20	14	9			
III	20	13	9			
IV	30	18	12			
Total	90	60	40	10	50	

4C04 MAT-CS: Mathematics for Computer Science - IV

Module I : Vector Differential Calculus and its Applications to Computer Science (25 hrs)

Vector and scalar functions and Fields, Derivatives, Curves, Arc Length, Curvature, Torsion, Gradient of a scalar field; Directional Derivative, Divergence of a vector field, Curl of a Vector Field. [Chapter 9 Sections 9.4 to 9.9 (Excluding 9.6) of Text 1]. Applications related to Computer Science of this module for assignment/seminar only (See the relevant projects in the Text 1).

Module II : Vector Integral Calculus and its Applications to Computer Science (25 hrs)

Line Integrals, Path Independence of Line Integrals, Green's Theorem in the Plane (without proof), Surfaces for Surface Integrals, Surface Integrals, Triple Integrals, Divergence theorem of Gauss, Stoke's theorem (without proofs).[Chapter 10 Sections 10.1 to 10.9 (Excluding 10.3 and 10.8) of Text 1]. Applications related to Computer Science of this module for assignment/seminar only (See the relevant projects in the Text 1).

Module III Numerical Analysis – I (25 hrs)

Solution of Algebraic and Transcendental Equation: Bisection Method, Method of false position, Newton-Raphson Method (Chapter 2 Sections 2.2, 2.3 and 2.5 of Text 2)

Finite Differences : Forward differences, Backward differences. (Chapter 3 Sections 3.3.1 and 3.3.2 of Text 2)

Interpolation: Newton's formulae for intrapolation, Langrange's interpolation formula, Divided differences and their properties.(Chapter 3 Sections 3.6, 3.9.1 and 3.10 of Text 2)

Numerical Differentiation and Integration: Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule. (Chapter 5 Sections 5.2, 5.4, 5.4.1 and 5.4.2 of Text 2)

Module IV Numerical Analysis – II (15 hrs)

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method. (Sections 7.1 to 7.4, 7.4.2 and 7.5 of Text 2)

Texts:
1. E. Kreyszig, Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. S.S. Sastry, Introductory Methods of Numerical Analysis, Fourth Edition, PHI.

References:

1. H. F. Davis & Arthur David Snider, *Introduction to Vector Analysis*, 6th ed., Universal Book Stall, New Delhi.
2. M. R. Spiegel, *Vector Analysis*, Schaum's Outline Series, Asian Student edition.
3. S. Sankara Rao,*Numerical Methods of Scientists and Engineers*, 3rd ed., PHI.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	25	15	10	10	50	3
II	25	15	10			
III	25	18	12			
IV	15	12	8			
Total	90	60	40	10	50	

MATHEMATICS (COMPLEMENTARY COURSE)
SYLLABUS FOR BCA

1C01MAT-BCA: Mathematics for BCA -I

Module I : Differential Calculus and its Applications I (20 hrs)

Hyperbolic Functions, Derivation of parametrically defined functions, Logarithmic Differentiation. (Sections 4.7, 4.8 and 4.9 of Text 1)

Higher Order Derivatives-Calculation of the n^{th} derivative – some standard results-determination of n^{th} derivative of rational functions - the n^{th} derivatives of the products of the powers of sines and cosines - Leibniz's theorem on n^{th} derivative of a product of two functions (without proof) [Sections 5.1 to 5.5 of Text 1].Maclaurin's Theorem and Taylor's Theorem (without proofs). Applications related to Computer Science of this module for assignment/seminar only (See the Rerence 1). (Sections 6.1 and 6.2 of Text 1)

Module II : Differential Calculus and its Applications II (20 hrs)

Rolle's theorem, Lagrange's mean value theorem, Meaning of the sign of derivative, Cauchy's mean value theorem, higher derivatives (all theorems without proofs). (Sections 8.1, 8.2, 8.3, 8.5 and 8.6. (excluding 8.4 and 8.7) of Text 1)

Indeterminate forms, the indeterminate form 0/0, the indeterminate form ∞/∞, the indeterminate form $0\cdot\infty$, the indeterminate form $\infty - \infty$, the indeterminate forms 0^0, 1^∞, ∞^0. Applications related to Computer Science of this module for assignment/seminar only (See the Rerence 1). (Sections 10.1 to 10.6 of Text 1)

Module III : Differential Calculus and its Applications III (22 hrs)

Partial Differentiation: Introduction, Functions of two variables, Neighbourhood of a point (a, b), continuity of a function of two variables, continuity at a point, limit of a function of two variables, homogeneous functions, Theorem on Total Differentials, Composite functions, Differentiation of Composite functions, Implicit Functions [Sections 11.1 to 11.10 of Text 1 (Proof of Theorem 11.10.1 omitted)

Curvature and Evolutes: Introduction, Definition of Curvature, Length of arc as a function derivative of arc, Radius of curvature (Cartesian Equations), Centre of Curvature, Chord of Curvature, Evolutes and Involutes, Properties of the Evolute. Applications related to Computer Science of this module for assignment/seminar only (See the Rerence 1).
(Sections 14.1, 14.2, 14.3, 14.5, 14.6 and 14.7 (excluding 14.4 and 14.8) of Text 1)

Module IV : Geometry (10 hrs)

Two Dimensional Geometry–Polar coordinates [Section 9.6 of Text 2]
Three Dimensional Geometry – Cylindrical and Spherical Coordinates.
(Section 10.7 of Text 2)

Texts:

1. S. Narayan and P. K. Mittal, *Differential Calculus*, S. Chand (Shyamlal Charitable Trust), New Delhi.
2. Thomas and Finney: *Calculus and Analytic Geometry*, 9th Eddition., Pearson Education.

References:

1. E. Kreyszig, *Advanced Engineering Mathematics,* 9th Edition, John Wiley & Sons.
2. Anton, Bivens, Davis, *Calculus*, 7th edition, Wiley-India.
3. N. P. Bali, M. Goyal, *Engineering Mathematics*, 8th Edition, Laxmi Publication.
4. Dr. B. S. Grewal, *Higher Engineering Mathematics,* 40th Edition, Khanna Publishers.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

2C02MAT-BCA: Mathematics for BCA -II

Module I: Integral Calculus (18 hrs)

Areas of Plane Regions - Area enclosed by two curves, quadrature of a hyperbola, Sectorial Area, Area bounded by a closed curve (formulae without proof).
[Sections 8.1, 8.2, 8.3, 8.4 of Text 1]

Rectification, lengths of plane curves: Introduction, Cartesian equations, Other expressions for lengths of arc, Intrinsic equation of a curve, rectification of ellipse (formulae without proof). [Sections 9.1, 9.2, 9.3, 9.4 and 9.5 of Text 1]

Multiple Integrals: Multiple Integrals, Double integral, Applications of Double Integration, Change of order of integration, Triple integrals. [Sections 12.1 to 12.4 and 12.6 of Text 1 *Excluding the section* Change of the variable in a Multiple Integral].

Module II: Matrices I (18 hrs)

Matrices, Vectors: Addition and Scalar Multiplication, Matrix Multiplication (Excluding Motivation of Multiplication by Linear Transformations), Transposition, Special Matrices, Applications of Matrix Multiplication, Linear Systems of Equations, Gauss Elimination, Elementary Row Operations, Row equivalent Systems, Linear Independence, Rank of a Matrix, Vector Space, Solutions of Linear Systems - Existence, For Reference: Second and Third Order Determinants, Determinants – Cramer's Rule, Inverse of a Matrix: Gauss-Jordan Elimination, Uniqueness, Reduction formulae [Sections 7.1 to 7.8 of Text 2].

Module III: Matrices II (18 hrs)

Linear Algebra, Matrix Eigen Value Problems: Eigen values, Eigen vectors, Symmetric, Skew Symmetric and Orthogonal Matrices, Eigenbases, Diagonalization, Qudratic Forms (proofs of all theorems omitted).
[Sections 8.1, 8.3 and 8.4 (excluding 8.2 and 8.5) of Text 2].

Cayley-Hamilton Theorem: Cayley-Hamilton Theorem (statement without proof) and its simple applications (finding $A^2, A^3, \cdots$ of a given square matrix A, finding A^{-1} of a non-singular matrix A) [Section Cayley-Hamilton Theorem in Chapter 23 of Text 3].

Module IV : Graph Theory (18 hrs)

Elements of graph theory : Introduction, The Konigsberg Bridge Problem, Four Colour Problem. Graphs & Subgraphs: Introduction, Definition and Examples, degrees, Sub Graphs, Isomorphism (upto and including definition of automorphism), Matrices, Operations on Graphs [Chapter 2, Sections 2.0 to 2.4, 2.8 and 2.9 of Text 4].

Degree Sequences: Introduction, Degree sequences, Graphic sequences, [Chapter 3, Sections 3.0 to 3.2 of Text 4].

Definitions and examples of Walks, Trials, Paths and Connectedness [Chapter 4 upto Theorem 4.4 of Text 4]. Definition and properties of Directed graphs .
[Chapter 10 upto and including theorem 10.1 of Text 4].

Texts:

1. S. Narayan and P. K. Mittal, *Integral Calculus*, S. Chand and Company Ltd., New Delhi.
2. E. Kreyszig, *Advanced Engineering Mathematics,* 9^{th} Edition, John Wiley & Sons, Inc.
3. J. R. Frank Ayres, *Theory of and Problems of Matrices*, Schaum's Outline Series, McGraw-Hill.
4. Arumugham & Ramachandran, Invitation to Graph theory, Scitech Publications, Chennai .

References:

1. Anton, Bivens, Davis, *Calculus*, 7^{th} Edition, Wiley-India.
2. N.P. Bali, M. Goyal, *Engineering Mathematics*, 8^{th} Edition, Laxmi Publication (P) Ltd.
3. S. S. Sastry, *Engineering Mathematics,* Volume II, 4^{th} Edition, PHI.
4. J. Clark & D. A. Holton, A First look at Graph Theory, Allied Publishers.

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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

3C03MAT-BCA: Mathematics for BCA -III

Module I : First Order Ordinary Differential Equations (20 hrs)

Basic concepts, Modeling, and ideas, Geometrical meaning of $y' = f(x, y)$. Direction Fields, Separable ODEs, Modeling, Exact ODEs, Integrating Factors, Linear ODEs, Bernoulli Equation, Population Dynamics, Orthogonal Trajectories, Existence and Uniqueness of Solution (proof of theorem omitted). (Chapter 1 Sections 1.1 to 1.7).

Module II: Second Order Ordinary Differential Equations (20 hrs)

Homogeneous Linear ODEs of second order, Homogeneous Linear ODEs with constant coefficients, Differential Operators, Euler-Cauchy Equation, Existence and Uniqueness of Solutions – Wronskian (statement of Theorems only, proofs omitted), Nonhomogeneous ODEs, Solution by variation of Parameters.
(Chapter 2 Sections 2.1 to 2.10 *Excluding* 2.4, 2.8 and 2.9)

Module III: Laplace Transforms (20 hrs)

Laplace Transform, Inverse Transform, Linearity, *s*-Shifting, Transforms of Derivatives and Integrals, ODEs, Unit step Function, *t*- Shifting, Short Impulses, Dirac's Delta Function, Partial Fractions, Convolution, Integral Equations, Differentiation and integration of Transforms, Systems of ODEs, Laplace Transform, General Formulas, Table of Laplace Transforms. [Chapter 6 Sections 6.1 to 6.9 (Proofs omitted)]

ModuleIV: Fourier Series and Partial Differential Equations (30 hrs)

Fourier Series : Fourier series, Functions of any period $p = 2L$, Even and Odd functions, Half-range Expansions. [Chapter 11 Sections 11.1 to 11.3 (Proofs omitted)]

Partial Differential Equations: Basic Concepts, Modeling, Vibrating String, Wave Equation, Solution by Separating Variables, Use of Fourier Series, D-Alembert's solution of the wave equation, Heat Equation, Solution by Fourier Series. [Chapter 12 sections 12.1 to 12.5 (*Excluding* steady two dimensional heat problems and Laplace equation of 12.5)]

Text : E. Kreyszig, Advanced Engineering Mathematics, 9th Edition, John Wiley & Sons, Inc.

References:

1. S.S. Sastry, Engineering Mathematics, Volume II, 4th Edition, PHI.
2. M. R. Spiegel, Advanced Calculus, Schaum's Outline Series.
3. M. R. Spiegel, Laplace Transforms, Schaum's Outline Series.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	15	10	10	50	3
II	20	14	9			
III	20	13	9			
IV	30	18	12			
Total	90	60	40	10	50	

4C04MAT-BCA: Mathematics for BCA -IV

Module I : Basic Statistics (25 hrs)

Basic Probability: Expectation (Section 3.7 of Text 1).

Random Variables: Introduction, Random variable, Expectation of a finite random variable, Variance and standard deviation, Joint distribution of random variables, Independent random variables, Functions of a random variable, Discrete random variables in general, Continuous random variables, Cumulative distribution function, Chebyshev's Inequality and the Law of large numbers (Sections 5.1 to 5.12 of Text 1).

Module II : Linear Programming (25 hrs)

Mathematical Formulation – simple examples (Sections 2.1 and 2.2 of Text 2).Graphical Solution (Sections 3.2, 3.4 and 3.5 of Text 2).

Simplex Method [Sections 4.1, 4.2 (Results Only) and 4.3 of Text 2].

Transportation Problems (Sections 10.1, 10.2, 10.3, 10.5, 10.8, 10.9, 10.10, 10.11 and 10.12 of Text 2).

Module III : Numerical Analysis – I (25 hrs)

Solution of Algebraic and Transcendental Equation: Bisection Method, Method of false position, Newton-Raphson Method. (Chapter 2 Sections 2.2, 2.3 and 2.5 of Text 3)

Finite Differences : Forward differences, Backward differences.
(Chapter 3 Sections 3.3.1 and 3.3.2 of Text 3)

Interpolation: Newton's formulae for interpolation, Langrange's interpolation formula, Divided differences and their properties. (Chapter 3 Sections 3.6, 3.9.1 and 3.10 of Text 3)

Numerical Differentiation and Integration: Numerical differentiation (using Newton's forward and backward formulae), Numerical Integration, Trapezoidal Rule, Simpson's 1/3-Rule. (Chapter 5 Sections 5.2, 5.4, 5.4.1 and 5.4.2 of Text 3)

Module IV : Numerical Analysis – II (15 hrs)

Numerical Solutions of Ordinary Differential Equations: Introduction, Solution by Taylor's series, Picard's method of successive approximations, Euler's method, Modified Euler's method, Runge-Kutta method. (Sections 7.1 to 7.4, 7.4.2 and 7.5 of Text 2)

Texts:

1. S. Lipschutz, J. Schiller, Introduction to Probablity and Statistics, Schaum's Outlines.
2. K. Swaroop, P K. Gupta and M. Mohan, Operations Research, 12th Edition, Sulthan Chand & Sons.
3. S. S. Sastry, Introductory Methods of Numerical Analysis, 4th Edition, PHI.

References:

1. S. S. Rao, *Numerical Methods of Scientists and Engineers*, 3rd Edition, PHI.
2. J. K. Sharma, Operations Research -Theory and Applications, McMillan, New Delhi.
3. G. Hadley, Linear Programming, Oxford & IBH Publishing Company, New Delhi.
4. H. A. Thaha, Operations Research- An Introduction, 8th Edition, Prentice Hall.

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<tr><td>Total</td><td>90</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
</table>

ASTRONOMY (COMPLEMENTARY COURSE)
SYLLABUS FOR B.Sc MATHEMATICS

1C 01 AST: ASTRONOMY- I

Module – I: Spherical Trigonometry

Sphere, Spherical Triangle, Polar Triangle Relation between them, cosine formula, sine formula, cotangent formula, five parts formula, Half angels, Napirer's analogies, Spherical Co-ordinates.

Module – II : (18 hrs)

Celestial spheres – Celestial sphere – Diurnal motion, cardinal points, Hemispheres, Annual motion, Ecliptic, Obliquity, celestial co-ordinate, change in the co-ordinates of the sun in the course of the year, sidereal time, latitude of a place, Relation between them, Hour angle of a body at rising and setting. Morning and evening star, circumpolar star, condition of circumpolar star, diagram of the celestial sphere.

Module – III: (18 hrs)

Earth – The zones of earth, variation in the duration of day and night, condition of perpetual day. Terrestrial latitude and longitude. Radius of earth – Foucault's Pendulum experiment.

Module – IV: (18 hrs)

History of Astronomy: Ancient History, modern history, famous astronomers, artificial satellites, probes, landing on moon, new planets, comet, meteors.

Text:

1. S. Kumaravelu, Astronomy for degree classes.
2. J.V. Narlikar, Introduction to cosmology.

Reference:

1. Bidyanath Basu , An introduction to Astrophysics.
2. Stefan Hofkings, A brief history of time.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	18	15	10	10	50	3
II	18	15	10			
III	18	15	10			
IV	18	15	10			
Total	72	60	40	10	50	

2C 02 AST: ASTRONOMY- II

Module – I: (18 hrs)

Dip of horizon, effects of Dip, Twilight, duration of twilight.

Module – II : (15 hrs)

Refraction, Laws of refraction, effect on RA and declination, shape of the disc, tangent formula, cassini's formula, effect on rising and setting.

Module –III : (15 hrs)

Geocentric parallax – effect on RA and declination, rising and setting, angular radius relation between them.

Module – IV: (24 hrs)

Helliocentric Parallax – effect of parallax on the longitude and latitude, parallatic ellipse, Parsec Aberration – effect of aberration on the longitude and latitude, annual, diurnal and planetary aberrations.

Text:

1. S. Kumaravelu, Astronomy for degree classes.
2. J.V. Narlikar, Introduction to cosmology.

Reference:

1. Bidyanath Basu , An introduction to Astrophysics.
2. Stefan Hofkings, A brief history of time.

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<tr><td>III</td><td>15</td><td>12</td><td>8</td></tr>
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<tr><td>Total</td><td>72</td><td>60</td><td>40</td><td>10</td><td>50</td></tr>
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3C 03 AST: ASTRONOMY- III

Module – I: (20 hrs)

Kepeler's law – Kepeler's laws of planetary motion, verification of laws in the case of earth, eccentric anomaly, mean anomaly, and true anomaly relation between them.

Module – II: (20 hrs)

Time - Equation of time, mean sun, true sun, effect of equation of time, seasons, coures seasons, calendar – different kinds of year, Julien and Gregorion calendars – conversion of time, relation between them.

Module – III: (20 hrs)

Moon – sidereal month, synodic month phases of moon, age of the moon, summer and winter, full moon, golden number, epact saros of chaldiens.

Module – IV: (30 hrs)

Precession and Nutations – Physical explanations, effect on R.A and declination, effect of length of seasons, cosmology – the large scale structure of the universe – general relativity, Eisten's universe, red shiff, Big bang theory – age of the universe Role of dark matter fate of the universe, singularity.

Text:

1. S. Kumaravelu, Astronomy for degree classes.
2. J.V. Narlikar, Introduction to cosmology.

Reference:

1. Bidyanath Basu , An introduction to Astrophysics.
2. Stefan Hofkings, A brief history of time.

Module	Teaching Hours	External Examination		Internal Mark	Total Mark	Credit
		Aggregate Mark	Maximum Mark			
I	20	15	10	10	50	3
II	20	14	9			
III	20	13	9			
IV	30	18	12			
Total	90	60	40	10	50	

4C 04 AST: ASTRONOMY- IV

Module – I: (20 hrs)

Astronomical observations – fixing the ecliptic fixing the equnutical points, determination of latitude of place method 1 to 4, fixing the meridian line methods 5, determination of local time method 1 to 3, determination of longitude of a place method 1 to 3.

Module – II: (20 hrs)

Eclipses – umbra, penembra, condition of totality of lunar and solar eclipses. Maximum and minimum number of eclipses (section 256 to 284).

Module – III: (20 hrs)

Planetary phenomena – Bodes law, Elognation conjenction, opposition, direct and retrograde motion, phase of the plant (section 285 to 302).

Module – IV: (30 hrs)

Solar system – The sum, the planets, astroids, comets, meteors. The stellar universe stellar motion, distance of star, magnitude of star, colour and size of star, main sequence star, Galaxy, Milky way.

Text:

1. S. Kumaravelu, Astronomy for degree classes.
2. J.V. Narlikar, Introduction to cosmology.

Reference:

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Sd/-
Prof. Jeseentha Lukka
Chairperson, BOS in Mathematics (UG).

KANNUR UNIVERSITY MODEL QUESTION PAPER

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

1B01MAT-Differential Calculus

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Find $\lim_{x\to c}\frac{x^3+4x^2-3}{x^2+5}$.

2. Fill in the blanks: $\frac{d}{dx}(\coth x) =$ ………………..

3. Find the Cartesian form of the polar equation

$$r=\frac{8}{1-2\cos\theta}.$$

4. Find the polar coordinates corresponding to the Cartesian coordinate $\left(-3, \sqrt{3}\right)$.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Find $\lim_{h\to 0}\frac{\sqrt{2+h}-\sqrt{2}}{h}$.

6. Find the inverse of $y=\frac{1}{2}x+1$, expressed as a function of x.

7. If $y=\sqrt{\sin x+\sqrt{\sin x+\sqrt{\sin x+\cdots}}}$ prove that

$$(2y-1)^2 y_2+2y_1\cos x+(2y-1)\sin x=0.$$

8. Find the Cartesian and spherical co-ordinates of the point whose cylindrical coordinates is $(1, \pi/2, 1)$.

9. Translate the Cartesian equation $x^2+y^2+z^2=4z$ into two other forms.

10. Verify Rolle's Theorem for the function f defined by

$$f(x) = (x-a)^m (x-b)^n,$$

where m and n being positive integers and $x \in [a, b]$.

11. Using Maclaurin's series expand e^{2x}.

12. Find points of inflection on the curve $y = 3x^4 - 4x^3 + 1$.

13. For the function $f(x, y) = y- x$,

    (a) find the function's domain,

    (b) find the function's range, and

    (c) describe the function's level curves.

14. Find the linearization of $f(x, y) = x^2 - xy + \frac{1}{2}y^2 + 12$ at the point $(3, 2)$.

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Show that

$$f(x) = \frac{x^2 + x - 6}{x^2 - 4}$$

is not continuous at $x = 2$, but has a continuous extension to $x = 2$, and find that extension.

16. Find the local and absolute extreme values of

$$f(x) = x^{\frac{1}{3}}(x-4) = x^{\frac{4}{3}} - 4x^{\frac{1}{3}}.$$

17. Find the asymptotes of the curve

$$y = \frac{x+3}{x+2}.$$

18. Using l'Hôpital's Rule, evaluate $\lim_{x \to 2^+} \frac{x^2 + 3x - 10}{x^2 - 4x + 4}$.

19. Using Chain Rule, find $\frac{dw}{dt}$ if

$$w = xy + z, \quad x = \cos t, \quad y = \sin t, \quad z = t.$$

What is the derivative's value at $t = \frac{\pi}{2}$.

20. Verify that $\frac{\partial^2 f}{\partial x \partial y} = \frac{\partial^2 f}{\partial y \partial x}$, where $f = x^y$.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. If $y = \left(\sin^{-1} x\right)^2$, prove that

$$\left(1 - x^2\right) y_{n+2} - (2n+1) x y_{n+2} - n^2 y_n = 0.$$

22. Find the equation of the sphere which is tangential to the plane $x - 2y - 2z = 7$ at the point $(3, -1, -1)$ and passes through the point $(1, 1, -3)$.

23. Find the centre of curvature and the evolute of the four cusped hypocycloid $x^{2/3} + y^{2/3} = a^{2/3}$.

24. If $u = \tan^{-1}\left(\frac{x^3 + y^3}{x - y}\right)$, $x \neq y$ show that

(i) $x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = \sin 2u.$

(ii) $x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = (1 - 4\sin^2 u) \sin 2u.$

KANNUR UNIVERSITY MODEL QUESTION PAPER

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

2B02MAT-Integral Calculus

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give an example of improper integral of third kind.
2. Fill in the blanks: The equation

   $\frac{x^2}{a^2}+\frac{y^2}{b^2}+\frac{z^2}{c^2}=1$ represents a surface known as …………………

3. Evaluate $\int_0^1\int_0^2 xy(x-y)dxdy$
4. Evaluate $\int_0^1\int_0^2\int_0^2 x^2 yz\ dz\ dy\ dx\cdot$

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Express the limit of Riemann sums

   $$\lim_{\|P\|\to 0}\sum_{k=1}^{n}(3c_k^2-2c_k+5)\Delta x_k$$

   as an integral if P denotes a partition of the interval $[-1, 3]$.

6. Find the average value of $f(x)=4-x^2$ on $[0, 3]$. Does f actually take on this value at some point in the given domain?
7. Find the area of the region between the x-axis and the graph of $f(x)=x^3-x^2-2x, -1\le x\le 2$.
8. Evaluate $\int_0^{\pi/2} 2\sinh(\sin t)\cos t\,dt$.

9. Investigate the convergence of $\int_1^{\infty} \frac{dx}{x}$ and $\int_1^{\infty} \frac{dx}{x^2}$.

10. Express $\int_0^2 (8-x^3)^{-1/3}\, dx$ in terms of a Beta function.

11. Find the area between $y = \sec^2 x$ and $y = \sin x$ from 0 to $\pi/4$.

12. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.

13. Find the length of the astroid

$$x = \cos^3 t, \quad y = \sin^3 t, \quad 0 \le t \le 2\pi$$

14. Evaluate

$$\iint_R e^{x^2+y^2}\, dy\, dx,$$

where R is the semicircular region bounded by the x-axis and the curve $y = \sqrt{1-x^2}$

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Show that if f is continuous on $[a, b], a \neq b$, and if $\int_a^b f(x)dx = 0$, then $f(x) = 0$ at least once in $[a, b]$.

16. Test for convergence the improper integral $\int_3^6 \frac{\log x}{(x-3)^4}\, dx$

17. A pyramid 3 m high has a square base that is 3 m on a side. The cross section of the pyramid perpendicular to the altitude x m down from the vertex is a square x m on a side. Find the volume of the pyramid.

18. For the catenary $y = c\cosh\frac{x}{c}$, show that $y^2 = c^2 + s^2$, where s is the length of the arc measured from its vertex to the point (x, y).

19. Change the order of integration and hence evaluate the double integral $\int_0^1 \int_{e^x}^{e} \frac{dx\, dy}{\log y}$

20. Evaluate

$$\int_0^4 \int_{x=y/2}^{x=(y/2)+1} \frac{2x-y}{2} dx\, dy$$

by applying the transformation

$$u = \frac{2x-y}{2}, \quad v = \frac{y}{2}$$

and integrating over an appropriate region in the uv-plane.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. Show that

$$\int x \sin^{-1} x\, dx = \left(\frac{x^2}{2} - \frac{1}{4}\right) \sin^{-1} x + \frac{1}{4} x\sqrt{1-x^2} + C,$$

where C is an arbitrary constant.

22. Show that

$$\int_0^1 \frac{x^{m-1}(1-x)^{n-1}}{(a+bx)^{m+n}} dx = \frac{1}{(a+b)^m a^n} \beta(m,n)$$

23. Find the area of the surface generated by revolving the right-hand loop of the lemniscate $r^2 = \cos 2\theta$ about the $y-$axis.

24. Find the volume of the upper region D cut from the solid sphere $\rho \le 1$ by the cone $\phi = \pi/3$.

KANNUR UNIVERSITY MODEL QUESTION PAPER

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

3B03MAT-Elements of Mathematics - I

Time: Three Hours Maximum Marks: 48

Section A

All the first* 4 *questions are compulsory. They carry* 1 *mark each.

1. Fill in the blanks: If A is a set with $m \in \square$ elements and $C \subseteq A$ is a set with 1 element, then $A \setminus C$ is a set with ………….. elements.

2. Give the remainder obtained when a polynomial $f(x)$ is divided by $x - a$.

3. State Sturm' Theorem.

4. State True/False: Square of any integer is either $3k$ or $3k+1$.

Section B

Answer any* 8 *questions from among the questions* 5 *to* 14. *These questions carry* 2 *marks each.

5. Prove that if A and B are denumerable, then $A \cup B$ is denumerable.

6. Show that $\sqrt{2}$ is irrational.

7. Form the polynomial equation of fourth degree with rational coefficients, one of whose roots is $\sqrt{2} + \sqrt{-3}$.

8. If α, β and γ are the roots of the equation $x^3 + ax^2 + bx + c = 0$, form the equation whose roots are $\alpha\beta, \beta\gamma$ and $\gamma\alpha$.

9. If $\alpha, \beta, \gamma, \delta$ are the roots of

$$x^4 + px^3 + qx^2 + rx + s = 0,$$

find the value of $\sum \alpha^2\beta$.

10. Discuss the nature of roots of the equation

$$x^9 + 5x^8 - x^3 + 7x + 2 = 0.$$

11. Find the sum of the trigonometric series $\sin x + \sin 2x + \sin 3x + \cdots$

12. Show that the expression $\frac{a(a^2+2)}{3}$ is an integer for all $a \geq 1$.

13. If a and b are given integers, not both zero, then prove that the set

$$T = \{ax + by \mid x, y \text{ are integers}\}$$

is precisely the set of all multiples of $d = \gcd(a, b)$.

14. Let $n > 1$ be fixed and *a, b* be arbitrary integers. Then prove the following properties:

(a) $a \equiv a (\text{mod } n)$.

(b) If $a \equiv b (\text{mod } n)$, then $b \equiv a (\text{mod } n)$.

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. State and prove Cantor's Theorem.

16. Prove that in a polynomial equation with real coefficients imaginary roots occur in conjugate pairs.

17. Solve the reciprocal equation

$$60x^4 - 736x^3 + 1433x^2 - 736x + 60 = 0.$$

18. Solve the equation $x^3 + x^2 - 16x + 20 = 0$, given that some of its roots are repeated.

19. Prove that the linear Diophantine equation $ax + by = c$ has a solution if and only if $d \mid c$, where $d = \gcd(a, b)$.

20. Using the Sieve of Eratosthenes find all primes not exceeding 60.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. (a) Show that the propositions $p \to q$ and $\neg p \vee q$ are logically equivalent

(b) Use quantifiers to express the statement “There is a woman who has taken a flight on every airline in the world.”

22. If α, β, γ are the roots of $x^3 - x - 1 = 0,$ find the equation whose roots are

$$\frac{1+\alpha}{1-\alpha}, \frac{1+\beta}{1-\beta}, \text{ and } \frac{1+\gamma}{1-\gamma}.$$

Hence write down the value of $\sum \frac{1+\alpha}{1-\alpha}.$

23. Solve the cubic

$$x^3 - 9x + 28 = 0$$

by Cardan’s method.

24. State and prove the Fundamental Theorem of Arithmetic.

KANNUR UNIVERSITY MODEL QUESTION PAPER

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

4B04 MAT-Elements of Mathematics - II

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Let $A = \{1, 2\}$ and $B = \{a, b, c\}$. Then $A \times B =$ ....

2. Give the partition of the set $S = \{a, b, c, d\}$ that contain 4 distinct cells.

3. Give the rank of the matrix $\begin{bmatrix} 1 & 2 \\ 2 & 4 \end{bmatrix}$

4. Find the matrix that is obtained by multiplying second row of the matrix

$$\begin{bmatrix} 1 & 0 & 0 & 0 \\ 0 & 5 & 3 & 7 \\ 0 & 4 & 9 & 10 \\ 0 & 0 & 0 & 0 \end{bmatrix}$$

by 7.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Let A be a set of nonzero integers and let $\approx$ be the relation on $A \times A$ defined as follows:

$(a, b) \approx (c, d)$ whenever $ad = bc$

Prove that $\approx$ is an equivalence relation.

6. Let the function f and g be defined by $f(x) = 2x + 1$ and $g(x) = x^2 - 2$. Find the formula defining the composition functions: (a) $g \circ f$; (b) $f \circ g$

7. Let n denote a positive integer. Suppose a function L is defined recursively as follows:

$$L(n) = \begin{cases} 0 & \text{if } n = 1 \\ L(\lfloor n/2 \rfloor) + 1 & \text{if } n > 1 \end{cases}$$

where $\lfloor x \rfloor$ denotes the floor of x. Find L (25).

8. Define the following . Give one example to each:

   i. Bounded Lattice.

   ii. Distributive Lattice.

   iii. Non-distributive Lattice.

   iv. Join Irreducible elements.

9. Give an example of a collection S of sets ordered by set inclusion, and a subcollection $A = \{A_i : i \in I\}$ of S such that $B = \bigcup_i A_i$ is not an upper bound of A.

10. Show that the tangent at the vertex of a parabola is perpendicular to the axis.

11. Obtain the condition that the line

$$y = mx + c$$

with slope m be the tangent to the ellipse

$$\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1.$$

12. Find the equation of the polar of (x_1, y_1) with respect to

    the parabola $y^2 = 4ax.$

13. Prove that the eccentric angles of the ends of a pair of conjugate diameters differ by a right angle.

14. Reduce to normal form the matrix

$$A = \begin{bmatrix} 2 & -2 & 0 & 6 \\ 4 & 2 & 0 & 2 \\ 1 & -1 & 0 & 3 \\ 1 & -2 & 1 & 2 \end{bmatrix}$$

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Suppose $P = \{A_i\}$ is a partition of a set S. Then there is an equivalence relation □ on S such that the quotient set $S/$□ of equivalence classes is the same as the partition $P = \{A_i\}$..

16. Determine if each of the following functions is one-to-one:
    (a) To each person on the earth assign the number which corresponds to his age.
    (b) To each country in the world assign the latitude and longitude of its capital.
    (c) To each state in India assign the name of its capital.
    (d) To each book written by only one author assign the author.
    (e) To each country in the world which has a prime minister assign its prime minister.

17. Let L be a lattice. Prove the following:
    i. $a \wedge b = a \Leftrightarrow a \vee b = b.$
    ii. The relation $a \leq b$ (defined by $a \wedge b = a$) is a partial order on L.

18. Two conjugate diameters of an ellipse with axes parallel to the coordinate axes are parallel to 2x + 6y = and 4y = 4x + 5. Find the eccentricity of the ellipse.

19. Obtain the equation of the asymptotes to the hyperbola

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

20. Find the rank of the following matrix by reducing it to the row reduced echelon form:

$$A = \begin{bmatrix} 1 & 2 & 3 & 0 \\ 2 & 4 & 3 & 2 \\ 3 & 2 & 1 & 3 \\ 6 & 8 & 7 & 5 \end{bmatrix}$$

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. Consider the set $\mathbb{Z}$ of integers. Define $a \preceq b$ if $b = a^r$ for some positive integer r. Show that $\preceq$ is a partial ordering of $\mathbb{Z}$.

22. Let L be a finite distributive lattice. Then show that every a in L can be written uniquely as the join of redundant join-irreducible elements.

23. Find the locus of the point of intersection of perpendicular tangents to the hyperbola $\dfrac{x^2}{a^2} - \dfrac{y^2}{b^2} = 1$.

24. Using elementary row transformations, compute the inverse of the matrix

$$A = \begin{bmatrix} -1 & -3 & 3 & -1 \\ 1 & 1 & -1 & 0 \\ 2 & -5 & 2 & -3 \\ -1 & 1 & 0 & 1 \end{bmatrix}.$$

MODEL QUESTION PAPER

KANNUR UNIVERSITY

5B05 MAT : REAL ANALYSIS

Time: 3 Hours **Maximum Marks: 48**

SECTION – A

(Answer all the Questions, Each Question carries one Marks.)

1. Define the completeness property of R.
2. State the comparisons Test for series.
3. What is the sequential criterion for continuity?
4. State Bolzano's Intermediate value theorem.

(4 X 1 = 4)

SECTION – B

(Answer any Eight Questions, Each Question carries two Marks.)

5. Prove that there does not exist a rational number r such that $r^2 = 2$.
6. Prove that $Sup(a+S) = a + SupS$, where S is a subset of R and $a \in R$.
7. If $a, b \in R$, then prove that $||a| - |b|| \leq |a-b|$.
8. Prove that a convergent sequence of real numbers is bounded.
9. If the series $\sum x_n$ converges, then $\lim(x_n) = 0$.
10. Prove that the series $\sum \frac{1}{n^2+n}$ convergent.
11. Establish the convergent or the divergence of the series whose nth term is $\frac{1}{(n+1)(n+2)}$.
12. State and prove the Abel's Test.
13. Prove that, Let I be an interval and let f: I $\rightarrow$ R be continuous on I, then the set f(I) is an interval.
14. Prove that if f: A $\rightarrow$ R is a Lipchitz function, then f is uniformly continuous on A.

(8 X 2 = 16)

SECTION C

(Answer any four Questions, Each Question carries four Marks.)

15 State and prove the Archimedean property.

16 Show that if A and B are bounded subsets of R, then $A \cup B$ is bounded set. Also show that sup($A \cup B$) = sup{sup A, sup B}.

17 State and prove the squeeze theorem.

18 State and prove the Monotone subsequence theorem.

19 Prove that every absolutely convergent series is convergent. Is the converse true.

20 Let I be subset of R be an open interval and let f: I $\rightarrow$ R be monotone on I. then the set of points at which f is discontinuous is a countable set.

(4X 4 = 16)

SECTION D

(Answer any two Questions, Each Question carries six Marks.)

21.	a) State and prove the Nested interval Property.	**4**
	b) Prove that the set R of real numbers is not countable	**2**
22.	a**)** Define Contractive Sequence.	2
	b) Prove that every contractive sequence is convergent.	4
23.	. a) Define alternating series. .	**2**
	b) State and prove the Criterion for the convergence of alternating series.	4
24.	State and prove the Location of Roots Theorem.	6

(2X 6 = 12)

MODEL QUESTION PAPER

KANNUR UNIVERSITY

5B06 MAT: ABSTRACT ALGEBRA

Time: 3 Hours **Maximum Marks: 48**

SECTION – A

(Answer all the Questions, Each Question carries one Marks.)

1. How many binary operations can be defined on a set containing ***n*** elements?
2. What is the order of $\sigma = (1,4)(3,5,7,8)$?
3. Define the maximal normal subgroup of a group G.
4. Find the characteristic of the ring Z_6 X Z_{15} .

(4 X 1 = 4)

SECTION – B

(Answer any Eight Questions, Each Question carries two Marks.)

5. Show that if G is a finite group with identity **e** and an even number of elements, then there is an element $\mathbf{a} \neq \mathbf{e}$ in G such that a*a = e.
6. Prove that every cyclic group is abelian.
7. Prove that every permutation σ of a finite set is a product of disjoint cycles.
8. State and prove Lagrange theorem.
9. Find all cosets of the subgroup 4Z of Z.
10. Prove a group homomorphism $\varphi : G \rightarrow G'$ is one to one map if and only if Ker (φ) = {e}.
11. Find Ker (φ) and φ(25) for the homomorphism $\varphi : Z \rightarrow Z_7$ such that φ(1) = 4.
12. Find the order of the factor group $Z_6 / < 3 >$.
13. Show that if a and b are nilpotent elements of a commutative ring R, the a+b is also nilpotent.
14. Prove that every finite integral domain is a field.

(8 X 2 = 16)

SECTION C

(Answer any four Questions, Each Question carries four Marks.)

15. Let G be a cyclic group with generator a. If the order of G is infinite, then G is isomorphic to (Z, +). If G has finite order n, then G is isomorphic to (Z_n , $+_n$).
16. Let A be a non empty set and let S_A be the collection of all permutations of A, then S_A is a group under permutation multiplication.
17. Prove that if $n \geq 2$, then the collection of all even permutations of {1, 2, 3, . . . n} forms a subgroup of order n!/2 of the symmetric group S_n .
18. Prove that M is a maximal normal subgroup of G if and only if G/M is simple.
19. State and prove the Fundamental Homomorphism theorem for a group.
20. Show that in a ring R, $a^2 = a \ \forall a \in R$,then R is a commutative ring.

(4X 4 = 16)

SECTION D

(Answer any two Questions, Each Question carries six Marks.)

21. a) Prove that subgroup of a cyclic is cyclic 3

b) Let p and q be distinct prime numbers. Find the number of generators of the cyclic group Z_{pq} . 3

22. State and prove Cayley's theorem 6

23. Let G be a group.

a) Define the commutator subgroup of G. 1

b) Show that commutator subgroup, C is a normal subgroup of G. Furthermore if N is a normal subgroup of G , then G/N is abelian if and only if $C \leq N$ 5

24. a) Define zero divisors. Give example. 2

b) Show that the set G_n of nonzero elements of Z_n that are not zero divisors forms a group under multiplication modulo n. 4

(2X 6 = 12)

KANNUR UNIVERSITY MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

5B07MAT-Differential Equations, Laplace Transforms and Fourier Series

Time: Three Hours — Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Obtain the differential equation associated with the primitive

$$y = Ax^2 + Bx + C.$$

2. Give a solution of the differential equation $\frac{dy}{dx} = \cos x.$

3. Give a solution of the homogeneous linear second order differential equation

$$y'' + y = 0.$$

4. State True/False: e^{2x} and e^{2x} are linearly independent functions.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky$; $y(0) = 0$, where a, b, k are constants.

6. Show that the equation

$\cos x(\cos x - \sin a \sin y)dx + \cos y(\cos y - \sin a \sin x)dy = 0$ is exact and solve it.

7. Solve the linear differential equation $y' - y = e^{2x}$.

8. Solve $x\frac{dy}{dx} + y = xy^3$.

9. Solve the initial value problem

$$(D^2 + 4D + 1)y = 0; \quad y(0) = 0, \quad y'(0) = -3,$$

where D is the differential operator.

10. Solve $x^2 y'' - 2.5xy' - 2y = 0$.

11. Using Linearity Theorem, obtain the value of $L(\cos at)$.

12. Find the inverse Laplace transform of $\frac{1}{s^2}\left(\frac{s+1}{s^2+a}\right)$.

13. Find the Fourier series of f given by

$$f(x)=\begin{cases}-k, & \text{when } -\pi<x<0\\ k, & \text{when } 0<x<\pi\end{cases} \quad \text{and} \quad f(x+2\pi)=f(x)$$

14. Find the Fourier series of the function

$$f(x)=x\sin x, \qquad 0<x<2\pi \qquad \text{and } f(x)=f(x+2\pi).$$

Section C

Answer any 4 questions from among the questions 15 to 20. These questions carry 4 marks each.

15. Solve the nonhomogeneous equation

$$y''-y'-2y=10\cos x.$$

16. Find a second-order homogeneous linear differential equation for which the functions e^{3x} and xe^{3x} are solutions. Find the Wronskian and use it to verify their linear independence.

17. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

18. Using convolution property, find $\mathcal{L}^{-1}\left[\frac{1}{\left(s^2+a^2\right)^2}\right]$

19. Find the Fourier series of the function

$$f(x)=\begin{cases}x+x^2 & -\pi<x<\pi\\ \pi^2 & \text{when } x=\pm\pi\end{cases}$$

Deduce that $1+\frac{1}{2^2}+\frac{1}{3^2}+\ldots=\frac{\pi^2}{6}$.

20. Find the Fourier integral representation of the function

$$f(x)=\begin{cases}1 & \text{if } |x|<1\\ 0 & \text{if } |x|>1\end{cases}$$

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. Find the orthogonal trajectory of the family of circles $(x-c)^2 + y^2 = c^2$.

22. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x .$$

23. Solve the initial value problem

$$y'' + 3y' + 2y = r(t),$$

where $r(t) = 1$ if $1 < t < 2$ and 0 otherwise, with the initial conditions $y(0) = y'(0) = 0.$

24. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \quad \text{for } x \in [0, \pi]$$

KANNUR UNIVERSITY MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

5B08 MAT – Vector Calculus

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give the vector equation for the line through $P_0(x_0, y_0, z_0)$ and parallel to the vector $\vec{v}$.
2. Give the formula for distance from a point S to a Line through P parallel to the vector $\vec{v}$.
3. Find the gradient field of $f(x, y, z) = xyz$.
4. Give the formula for the area of the surface $f(x, y, z) = c$ over a closed and bounded plane region R.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Find the angle between the planes $x + y = 1$ and $2x + y - 2z = 2$.
6. The vector
$$\mathbf{r}(t) = (6\cos t)\mathbf{i} + (6\sin t)\mathbf{j} + t^2\mathbf{k}$$
gives the position of a moving body at time t. Find the body's speed and acceleration when $t = 1$. At times, if any, are the body's velocity and acceleration orthogonal?
7. Find the unit tangent vector to the curve
$$x = t^2 + 1, \quad y = 4t - 3, \quad z = 2t^2 - 6t \text{ at the point } t = 2.$$
8. Find the angle between the surfaces $x^2 + y^2 + z^2 = 9$ and $z = x^2 + y^2 - 3$ at the point $(2, -1, 2)$.
9. Find the local extreme values of the function
$$f(x, y) = xy - x^2 - y^2 - 2x - 2y + 4.$$

10. Find $\operatorname{curl}\vec{v}$, where with respect to right handed Cartesian coordinates, $\vec{v} = xyz(x\mathbf{i} + y\mathbf{j} + z\mathbf{k})$.

11. Integrate $f(x, y, z) = x - 3y^2 + z$ over the line segment C joining the origin and the point $(1, 1, 1)$.

12. Find the flux of $\mathbf{F} = (x - y)\mathbf{i} + x\mathbf{j}$ across the circle $x^2 + y^2 = 1$ in the xy-plane.

13. Integrate $g(x, y, z) = xyz$ over the surface of the cube cut from the first octant by the planes $x = 1$, $y = 1$, and $z = 1$.

14. Find a parametrization of the cone

$$z = \sqrt{x^2 + y^2}, \qquad 0 \le z \le 1$$

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Find the curvature for the helix

$$\mathbf{r}(t) = (a\cos t)\mathbf{i} + (a\sin t)\mathbf{j} + bt\mathbf{k}, \quad a, b \ge 0,\ a^2 + b^2 \ne 0$$

16. Consider the function $f(x, y) = \frac{x^2}{2} + \frac{y^2}{2}$.

   a) Find the directions in which
      (i) f increases most rapidly at the point $(1, 1)$ and
      (ii) f decreases most rapidly at the point $(1,1)$.
   b) What are the directions of zero change in f at $(1,1)$?

17. Find a quadratic $f(x, y) = \sin x \sin y$ near the origin. How accurate is the approximation if $|x| \le 0.1$ and $|y| \le 0.1$?

18. Prove that $\operatorname{div}(\operatorname{grad} f) = \nabla^2 f$.

19. Show that $ydx + xdy + 4dz$ is exact, and evaluate the integral

$$\int_{(1,1,1)}^{(2,3,-1)} ydx + xdy + 4dz$$

over the line segment from $(1, 1, 1)$ to $(2, 3, -1)$.

20. Use Stokes's theorem to evaluate $\int_C \mathbf{F}\cdot d\mathbf{r}$, if $\mathbf{F} = xz\,\mathbf{i} + xy\,\mathbf{j} + 3xz\,\mathbf{k}$ and C is the boundary of the portion of the plane $2x + y + z = 2$ in the first octant traversed counterclockwise as viewed from above.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. Determine whether the following lines $L1$, $L2$ and $L3$ in space, taken two at a time, are parallel, intersect or are skew. If they intersect, find the point of intersection.

$$L1: \quad x = 3 + 2t, \quad y = -1 + 4t, \quad z = 2 - t, \quad -\infty < t < \infty$$
$$L2: \quad x = 1 + 4s, \quad y = 1 + 2s, \quad z = -3 + 4s, \quad -\infty < s < \infty$$
$$L3: \quad x = 3 + 2r, \quad y = 2 + r, \quad z = -2 + 2r, \quad -\infty < r < \infty$$

22. Find the greatest and smallest values that the function

$$f(x,\ y) = xy$$

takes on the ellipse $\frac{x^2}{8} + \frac{y^2}{2} = 1$.

23. Verify both forms of Green's theorem for the field

$$\mathbf{F}(x, y) = (x - y)\mathbf{i} + x\mathbf{j}$$

and the region R bounded by the unit circle
$C: \quad \mathbf{r}(t) = (\cos t)\mathbf{i} + (\sin t)\mathbf{j}, \quad 0 \le t \le 2\pi.$

24. Verify the Divergence Theorem for the field $\mathbf{F} = x\,\mathbf{i} + y\,\mathbf{j} + z\,\mathbf{k}$ over the sphere $x^2 + y^2 + z^2 = a^2$.

MODEL QUESTION PAPER

KANNUR UNIVERSITY

5B09 MAT : GRAPH THEORY

Time: 3 Hours **Maximum Marks: 48**

SECTION – A

(Answer all the Questions, Each Question carries one Marks.)

1. State the Whitney's theorem.
2. Define Euler Graphs.
3. Define Tournaments..
4. What is Cayley's Formula.

(4 X 1 = 4)

SECTION – B

(Answer any Eight Questions, Each Question carries two Marks.)

5. Prove that the number of vertices of odd degree is even.
6. Prove that if a simple graph G is not connected then G^c is connected.
7. Prove that every connected graph contains a spanning tree.
8. Prove that an edge ***e*** = xy is a cut edge of a connected graph G if and only if there exist vertices u and v such that ***e*** belongs to every u-v path in G.
9. Prove that for any graph G with ***n*** vertices ,
$$\alpha + \beta = n$$
10. Define Digraph ,in degree, Out degree with an example.
11. Prove that every tournament contains a directed Hamiltonian path.
12. Explain Directed Walk, Directed path, and Directed cycle.
13. Explain disconnected in a Digraph.
14. A subset S of V is independent if and only if V-S is a covering of G

(8 X 2 = 16)

SECTION C

(Answer any four Questions, Each Question carries four Marks.)

15. Explain the different operations on Graphs with examples.
16. Prove that the line graph of a simple graph G is a path if and only if G is a path.
17. Prove that the number of edges in a tree on ***n*** vertices is ***n-1.***
18. Prove that for a connected a graph G with at least two vertices contains at least two vertices that are not cut vertices.
19. Prove that for a simple graph G with $n \geq 3$ vertices, if for every pair of nonadjacent vertices u, v of G, $d(u) + d(v) \geq n$, then G is Hamiltonian.
20. Prove that every vertex of a disconnected tournament T on ***n** vertices* with $n \geq 3$ is contained in a directed k-cycle., $3 \leq k \leq n$.

(4X 4 = 16)

SECTION D

(Answer any two Questions, Each Question carries six Marks.)

21. a) Define bipartite Graph. 2

b) Prove that a Graph G is bipartite if and only if it contains no odd cycles. 4

22. Prove that for any loop less connected graph G,

$$\kappa(G) \leq \boldsymbol{\lambda(G)} \leq \boldsymbol{\delta(G)}$$

Give an example with strict inequality hold. 6

23. a) Define Centre and Centroids .of a Graph. 2

b) Prove that every tree has centre consisting of either a single vertex or two

adjacent vertices. 4

24. Prove that for any non trivial connected graph G , the following statements

are equivalent

I. G is Eulerian.
II. The degree of each vertex of G is an even positive integer.
III. G is an edge disjoint union of cycles. 6

(2X 6 = 12)

KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

6B10 MAT – Linear Algebra

Time: Three Hours | Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Justify that the field of rational numbers is not a vector space over the field of real numbers.
2. If $P_n[F]$ denotes the vector space of all polynomials of degree at most n in the variable x over the field of real numbers, then the dimension of $P_n[F]$ is ……………
3. Examine that T: $R^3 \to R^2$ defined by $T(x_1, x_2, x_3) = (x_3, x_1 + x_2)$ is a linear transformation.
4. Give the solution of the following system of linear equations:

$$2x + y + z = 10$$
$$y + 3z = 6$$
$$z = 5.$$

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Define vector space.
6. Show that $R^2 = R \times R$ is not a vector space over the field R of real numbers when the vector addition is defined by

$$(x_1, x_2) + (y_1, y_2) = (x_1 + y_1, x_2 + y_2)$$

and the scalar multiplication is defined by

$$r(x_1, x_2) = (r x_1, x_2),$$

where $x_1, x_2, y_1, y_2, r \in$ R.

7. Show that any intersection of subspaces of a vector space V is a subspace of V. Is the union of any two subspaces of a vector space V is a subspace of V? Justify your answer.

8. Give an example of a vector space V with a linear map $T: V \to V$ such that Null Space of T is equal to $T(V)$.

9. For any $n \times n$ matrix A, show that $I_n A = A I_n = A$. Also show that, if V is a finite-dimensional vector space of dimension n with an ordered basis β, then $[I_V]_\beta - I_n$.

10. State and prove Sylvester's Law of Nullity.

11. Find the eigen values of the matrix $A = \begin{bmatrix} 1 & 1 & 2 \\ 0 & 2 & 2 \\ -1 & 1 & 3 \end{bmatrix}$.

12. If A and P be square matrices of the same order and if P be invertible, then show that the matrices A and $P^{-1}AP$ have the same characteristic roots.

13. Applying Gauss elimination method, solve the following system of equations:

$$\begin{aligned} x + 4y - z &= -5 \\ x + y - 6z &= -12 \\ 3x + y - z &= 4 \end{aligned}$$

14. Using Gauss Jordan method solve the following system of equations:

$$\begin{aligned} 2x + 3y - z &= 5 \\ 4x + 4y - 3z &= 3 \\ -2x + 3y - z &= 1 \end{aligned}$$

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Show that the set B $=\{(1, 0, 0), (0, 1, 0), (0, 0, 1)\}$ is a basis for R^3.

16. State and prove Dimension Theorem.

17. Examine whether the following system of equations possess a non-trivial solution:

$$\begin{aligned} x + 2y - 3z &= 0 \\ 2x - 3y + z &= 0 \\ 4x - y - 2z &= 0 \end{aligned}$$

18. Test the following system of equations for consistence and solve it, if it is consistent.

$$\begin{array}{rcrcrcr} x & + & y & + & z & = & 6 \\ x & - & y & + & 2z & = & 5 \\ 3x & + & y & + & z & = & 8 \end{array}$$

19. State and prove Cayley Hamilton Theorem.

20. Use the Gaussian elimination method to find the inverse of the matrix

$$A = \begin{bmatrix} 1 & 1 & 1 \\ 4 & 3 & -1 \\ 3 & 5 & 3 \end{bmatrix}.$$

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. If a vector space V is generated by a finite set S_0, then show that a subset of S_0 is a basis for V and V has a finite basis.

22. Show that the function $T : R^2 \to R^2$ defined by

$$T(x,\ y) = (2x + 3y,\ 4x - 5y)$$

is a linear transformation. Also, find the matrix of T in the ordered basis $\beta = \{(1, 2), (2, 5)\}$.

23. Find the characteristic equation of the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$ and then verify Cayley Hamilton theorem. Also express $A^5 - 4A^4 - 7A^3 + 11A^2 - A - 10I$ as a linear polynomial in A.

24. Prove that $A = \begin{bmatrix} -1 & 4 & -2 \\ -3 & 4 & 0 \\ -3 & 1 & 3 \end{bmatrix}$ is diagonalizable and find the diagonal form.

KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

6B11MAT-Numerical Methods and Partial Differential Equations

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. State the central difference interpolation formula.
2. The order of the partial differential equation

$$\frac{\partial^4 u}{\partial x^4}+\frac{\partial^5 u}{\partial y^5}+\frac{\partial^6 u}{\partial z^6}=0$$

is ……………

3. Give the one dimensional heat equation.
4. Give the Laplacian equation in polar coordinates.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Solve $x^3 - 9x + 1 = 0$ for a root between $x = 2$ and $x = 4$, by bisection method.

6. Using regula-falsi method, find a real root of the equation

$f(x) = x^3 + x - 1 = 0$, near $x = 1$.

7. Construct the forward difference table for the following x values and its corresponding f values.

x	0.1	0.3	0.5	0.7	0.9	1.1	1.3
f	0.003	0.067	0.148	0.248	0.370	0.518	0.697

8. Express $\Delta^2 f_0$ and $\Delta^3 f_0$ in terms of the values of the function f.

9. Compute $f'(0.2)$ from the following tabular data.

x	0.0	0.2	0.4	0.6	0.8	1.0
$f(x)$	1.00	1.16	3.56	13.96	41.96	101.00

10. Using Taylor series, solve $y' = x - y^2, \quad y(0) = 1$.

11. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

12. Use Euler's method with h = 0.1 to solve the initial value problem $\frac{dy}{dx} = x^2 + y^2$ with $y(0) = 0$ in the range $0 \le x \le 0.2$.

13. Show that the function

$$u = \log(x^2 + y^2)$$

is a solution of the two dimensional Laplace equation.

14. Solve the partial differential equation $u_{xx} + 4u = 0$, where u is a function of two variables x and y.

Section C

Answer any 4 questions from among the questions 15 to 20. These questions carry 4 marks each.

15. Using general iteration method, find a real root of the equation $x^3 + x^2 - 1 = 0$ on the interval $[0, 1]$ with an accuracy of 10^{-4}.

16. Set up a Newton iteration for computing the square root of a given positive number. Using the same find the square root of 2 exact to six decimal places.

17. Using Newton's forward difference formula, find the sum

$$S_n = 1^3 + 2^3 + 3^3 + \cdots + n^3.$$

18. Use the trapezoidal rule with $n = 4$ to estimate

$$\int_1^2 \frac{1}{x} dx.$$

Compare the estimate with the exact value of the integral.

19. Solve the partial differential equation $u_y + 2yu = 0$, where u is a function of two variables x and y.

20. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x, \; z = x + y)$$

Section D

Answer any 2 questions from among the questions 21 to 24. These questions carry 6 marks each.

21. Using (a) Newton's divided difference formula and

(b) Lagrange's interpolation formula

find the interpolating polynomials for the following table.

x	0	1	2	4
$f(x)$	1	1	2	5

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

24. Derive d'Alemebert's solution of the wave equation .

KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (core)

6B12MAT: Complex Analysis

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Draw the graph: $\operatorname{Re}(z) \geq -2$.
2. Define an isolated point.
3. $\frac{\sin z}{z^4}$ has a pole of order ---- at $z = 0$
4. The residue of $\frac{4}{1-z}$ at its singular point is --------.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. Evaluate $\int_C |z|\,dz$ for $-i$ to i along the unit circle in the right half plane.
6. Evaluate $\int_C \frac{dz}{z^2-8}$ where C is the unit circle.
7. State Liouville's theorem and using it prove the Fundamental Theorem of Algebra.
8. Explain the difference between limit and limit point with suitable example.
9. Define a power series and prove that $\sum_{n-0}^{\infty} \frac{z^n}{n!}$ is absolutely convergent.
10. State Taylor's theorem and find the Taylor series of $\frac{1}{z}$ at $z = 1$.
11. Find the residue of $\tan z$ at its singular points.
12. Explain stereographic projection.
13. State and prove Cauchy's residue theorem.

14. If $f(z)$ is analytic and has a pole at $z = a$, then $|f(z)| \to \infty$ as $z \to a$ in any manner.

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Find the most general analytical function $f(z) = u(x, y) + iv(x, y)$ for which $u = xy$.

16. Find the locus of z satisfying $0 < \operatorname{Im}\frac{1}{z} < 1$

17. State and prove Bolzano-Weierstrass theorem for complex sequences.

18. State and prove the theorem of convergence of power series.

19. Find the Laurent series of $f(z) = \frac{1}{1 - z^2}$ with centre at $z = 1$.

20. Prove that the zeros of an analytic function $f(z)(\neq 0)$ are isolated.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. (a) State and prove parallelogram equality.

    (b) Prove that $\tan^{-1} z = \frac{i}{2}\ln\left(\frac{i+z}{i-z}\right)$

22. (a) State and prove Cauchy-Riemann equations.

    (b) Solve the equation : $z^4 + 5z^2 = 36$.

23. (a) Evaluate $\int_C \frac{dz}{1+z^3}$ where C is $|z + 1| = 1$ counter clockwise.

    (b) State and prove Cauchy's integral formula.

24. (a) State and prove Morera's theorem.

    (b) Integrate $\frac{z^2+1}{z^2-1}$ in the counterclockwise sense, around the circle of radius 1 with centre at $z = -1$ and $z = $ i.

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KANNUR UNIVERSITY MODEL QUESTION PAPER
Sixth SEMESTER B.Sc. DEGREE EXAMINATION
Mathematics (Core)
6B13MAT: Mathematical Analysis and Topology

Time: Three hours **Max marks:48**

Section A
Fill in the blanks. All the first 4 questions are compulsory.
They carry 1 mark each

1. If $P = \{a = x_0, x_1, x_2, ...x_n = b\}$ is a partition of $[a, b]$ then find the upper sum of a function $f : [a, b] \to R$, corresponding to P.
2. Find the radius of convergence of $\sum \frac{x^n}{n^2}$.
3. Fill in the blanks: The closure of set of all rational numbers is ....
4. Give an example of a set which contains a point which is not a limit point of the set.

Section B
Answer any 8 questions from among the questions 5 to 14.
These questions carry 2 marks each.

5. Define Riemann integral of a function $f : [a, b] \to R$.
6. State the first form of fundamental theorem of calculus.
7. Let $I = [a, b]$ and let $f : I \to R$ be integrable on I. Then prove that the power function $f^n, n \in N$ is integrable on I.
8. Prove that the sequence $f_n(x) = \frac{x}{n}, n \in N$ converges uniformly on $[0, 1]$.
9. If f_n is continuous $D \subseteq$ to R for each n in N and if $\sum f_n$ converges to f uniformly on D,prove that f is continuous on D.
10. Prove that union of open spheres in a metric space is an open set.
11. Let A and B be two subsets of a metric space X, prove that $\text{Int}(A) \cup \text{Int}(B) \subseteq \text{Int}(A \cup B)$
12. Prove that each closed sphere in a metric space is a closed set.

13. Let X be a topological space and let A be an arbitrary subset of x.Then prove that $\overline{A} = \{x \in X : \text{each neighbourhood of x intersects} A\}$

14. Give an example of a topology. Prove your claim.

Section C

Answer any 4 questions from among the questions 15 to 20. These questions carry 4 marks each

15. State and prove Cauchy criterion for uniform convergence.

16. State and prove first substitution theorem

17. If X is a metric space with metric d, prove that $d_1(x, y) = \frac{d(x,y)}{1+d(x,y)}$ is also a metric on X.

18. Prove that a subset of a topological space is perfect if and only if it has no isolated points.

19. Prove that any closed subset of a topological space is the disjoint union of its set of isolated points and its set limit points.

20. Prove that a monotone function $f : [a, b] \to R$ is integrable on $[a, b]$.

Section D

Answer any 2 questions from among the questions 21 to 24. These questions carry 6 marks each.

21. Let $I = [a, b]$, and if $f, g : I \to R$ are integrable on I prove that $f + g$ is integrable on I.

22. If $f : [a, b] \to R$ is continuous on $[a, b]$, then prove that there exist $c \in [a, b]$ such that $\int_a^b f = f(c)(b - a)$.

23. State and prove Cantors intersection theorem.

24. If $f : X \to Y$ is a mapping of one topological space to another show that f is continuous if and only if $f(\overline{A}) \subseteq \overline{f(A)}$

KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Elective)

6B 14A MAT: Operations Research

Time: Three Hours — Maximum Marks: 48

Section A

All the first* 4 *questions are compulsory. They carry* 1 *mark each.

1. Define a convex function.
2. Define dual problem.
3. What is transportation problem?
4. If there are n works and n jobs, there would be ----- solutions.

Section B

***Answer any* 8 *questions from among the questions* 5 *to* 14.**

These questions carry* 2 *marks each.

5. Show that the function $f(x) = 2x_1^2 + x_2^2$ is a convex function over all of $\mathbb{R}^2$
6. Determine whether the quadratic form $x_1^2 + 2x_2^2 + 2x_3^2 - 2x_1x_2 - 2x_2x_3$ is a positive definite.
7. What is infeasible solution? Illustrate it graphically.
8. Define basic solution and degenerate basic solution.
9. Describe an unbalanced transportation problem.
10. Explain loops in transportation tables.
11. Give two applications of assignment problem.
12. What is meant by sequencing? Illustrate with an example.
13. What is game theory? What are the various types of games?
14. Explain the concept of value of a game.

Section C

***Answer any* 4 *questions from among the questions* 15 *to* 20.**

These questions carry* 4 *marks each.

15. Write the major steps in the solution of the linear programming problem by graphical method.
16. Prove that the sum of convex function is convex.
17. Discuss a procedure to deal with the problem of degeneracy.
18. How will you solve the sequencing of n jobs on three machines?
19. Write a short note on maintenance crew scheduling.
20. Explain maximum minimax principle.

Section D

***Answer any* 2 *questions from among the questions* 21 *to* 24.**

These questions carry* 6 *marks each.

21. Explain the various steps involved in the formulation of a prime-dual pair.
22. Describe MODI method in transportation problem.
23. A book binder has one printing press, one binding machine, and the manuscripts of a number of different books. The time required to perform the printing and binding operations for each book is shown below. Determine the order in which books should be processed, in order to minimize the total time required to turn all the books:

Book	1	2	3	4	5	6
Printing time(hrs.)	30	120	50	20	90	100
Binding time (hrs.)	80	100	90	60	30	10

24. Solve the following game: Player B

$$
\text{Player A}\quad
\begin{array}{c} \\ \text{I} \\ \text{II} \\ \text{III} \\ \text{IV} \end{array}
\begin{array}{c}
\begin{array}{cccc} \text{I} & \text{II} & \text{III} & \text{IV} \end{array} \\
\begin{bmatrix} 3 & 2 & 4 & 0 \\ 3 & 4 & 2 & 4 \\ 4 & 2 & 4 & 0 \\ 0 & 4 & 0 & 8 \end{bmatrix}
\end{array}
$$

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KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

6B14B MAT: Mathematical Economics

Time: Three Hours Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. A model of price determination in an isolated market is known as ------- model.
2. When we say the linear equation system $Ax = d$ is non-singular?
3. In a non-linear programming problem the objective function is -------.
4. In Domar's model ------ is defined to be a situation in which productive capacity is fully utilized.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. What is two-commodity market model?
6. Find the zeroes of the function $f(x) = x^2 - 7x + 10$ graphically.
7. Define the following:

   (a) Feasible solution (b) Optimal solution
8. Define the coefficient of utilization in Domar's approach.
9. Find the equilibrium solution for

$$Q_d = Q_s$$
$$Q_d = 3 - P^2,\ Q_s = 6P - 4$$

10. Solve the national income model by Cramer's Rule

$$\begin{aligned} Y &= C + I_0 + G_0 \\ C &= a + bY, \quad (a > 0, \quad 0 < b < 1) \end{aligned}.$$

11. Assume that the rate of investment is described by the function $I(t) = 12t^{\frac{1}{3}}$ and

$K(0) = 25$. Find the time path of capital stock K

12. What is the present value of a perpetual cash flow of \$1450 per year discounted at $r = 5\%$

13. Given the output matrix and the final demand vector

$$A = \begin{bmatrix} 0.05 & 0.25 & 0.34 \\ 0.33 & 0.10 & 0.12 \\ 0.19 & 0.38 & 0 \end{bmatrix}, \quad \text{d}= \begin{bmatrix} 1800 \\ 200 \\ 900 \end{bmatrix}$$

(a) Explain the economic meaning of the elements 0.33, 0, 200.

(b) Explain the economic meaning of the third column sum.

(c) Write the input-output matrix equation for this model.

14. Define (a) Demand function (b) Supply function (c) Product function (d) Cost function.

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Solve by factoring the equation $x^3 + 2x^2 - 4x - 8 = 0$.

16. Explain partial market equilibrium as a

(i) linear model (ii) non-linear model .

17. (a) Define Marginal revenue function and Total revenue function.

(b) If the marginal revenue function is $R'(Q) = 10(1+Q)^{-2}$, find the total revenue function.

(c) What initial condition can introduce to definitize the constant of integration.

18. Write the structure of Leonitif input-output model.

19. Explain the term constraint qualification.

20. Give two economic applications of integrals.

Section D

Answer any 2 questions from among the questions 21 to 24. These questions carry 6 marks each.

21. (a) Explain Keynesian National income model.

(b) Find the equilibrium values of income and consumption expenditure for

$$Y = C + I_0 + G_0$$

$$C = 25 + 6Y^{\frac{1}{2}} \qquad A$$

$$I_0 = 16, \quad G_0 = 14$$

22. Define the norm of a matrix and explain the method for finding the inverse of a matrix by approximation.

23. What is a non-linear programming problem ? Write a short note on Kuhn-Tucker conditions .

24. Explain Domar’s growth model and find a solution for it.

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KANNUR UNIVERSITY MODEL QUESTION PAPER

SIXTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Core)

6B14C MAT: Classical Mechanics

Time: Three Hours | Maximum Marks: 48

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Define a rigid body.
2. State the law of reaction by Newton.
3. Define a couple.
4. Define centre of gravity.

Section B

Answer any 8 questions from among the questions 5 to 14. These questions carry 2 marks each.

5. State (i) Triangle law of forces and (ii) Lami's theorem.
6. State and prove the necessary condition of equilibrium for forces acting at a point.
7. A uniform triangular lamina ABC is suspended from the corner A and in equilibrium the side BC makes an angle θ by the horizontal. Prove that $2\tan\theta = \cot B \mid \cot C$.
8. Prove that the couples of equal moment in parallel planes are equivalent.
9. ABCDEF is a rectangular hexagon and G is its centre. Forces of magnitudes 1 ,2, 3, 4, 5, 6 act in the lines AB, CB, CD, ED, EF, AF in the senses indicated by the order of the letters. Reduce the system to a force at G and a couple, and find the point in AB through which the single resultant passes.
10. Define (i) Energy (ii) Kinetic energy (iii) Potential Energy.
11. Find the centre of gravity of a parallelogram.
12. Define coefficient of restitution and explain the direct impact of two spheres.
13. Find the Kinetic energy created by Impulses.

14. Show that the product of two times of flight from P to Q with a given velocity of projection is $\frac{2PQ}{g}$

Section C

Answer any* 4 *questions from among the questions* 15 *to* 20. *These questions carry* 4 *marks each.

15. Two forces given in magnitude act each through a fixed point and are inclined at a constant angle θ Show that (i) their resultant is also passes through fixed point A.

    (ii) If θ varies the locus of A is a circle.

16. Define coplanar forces and prove the necessary and sufficient condition of equilibrium of coplanar forces.

17. (a) State and prove principle of conservation of energy.

    (b) Derive the formula for kinetic energy.

18. (a) Find the centre of gravity of circular arc by integration.

    (b) If O is the pole of of the curve and G is the centre of gravity of any arc PQ of the curve, Prove that OG bisect the angle POQ .

19. (a) Define a material particle and momentum.

    b) Derive the formulae for impulse of a force.

20. Explain Poisson's Hypothesis.

Section D

Answer any* 2 *questions from among the questions* 21 *to* 24. *These questions carry* 6 *marks each.

21. a) Explain oblique Resolution of forces.

    b) Illustrate the difference between internal and external forces on particles.

22. Derive the analytical formulae for centre of the forces for

    a) Coplanar forces.

    b) Non coplanar forces.

23. Find the centre of gravity of

(i) Of a plane area bounded by a curve $y = f(x)$, the co-ordinate axes and an ordinate $x = a$.

(ii) Sectorial area bounded by a curve $r = f(\theta)$ and two radii $\theta = \alpha, \theta = \beta$.

24. (a) Prove that the motion of projectile is a parabola.

(b) Find the latus rectum, vertex, directrix of the above parabola.

(c) Find the range of an inclined plane through the point of projection.

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VI SEMESTER BSc (CCSS- REGULAR) DEGREE EXAMINATION
MATHEMATICS (Core Course - Elective)
Model Question Paper
6B14D MAT: Programming in Python (Theory)

Duration : 2 Hours | Maximum Marks 30

Section A
(Answer all, 1 Mark each)

1. What are the advantages of Python over mainstream languages.
2. Give four augmented assignment operators of Python .
3. What are the uses of Matplotlib Module.
4. How Formatted printing is done in Python.

Section B
(Answer any Four, 2 Marks each)

5. Explian the structure of a Python function with an Example.
6. What are Comparison operators in Python.Write a source codes to illustrate any two Comparison operators.
7. What is *numarray* Module.
8. Write Python Program to make a 3×3 matrix.
9. Write Python Source code to Plot Pie Chart.

Section C
(Answer any Three, 4 Marks each)

10. Explain Type Conversion in Python.
11. Explain three levels of *namespaces* in Python.
12. Write Python code to remove the last two characters of *'I am a long string'* by slicing, without counting the characters.
13. Explain the uses of the *NumPy* function *meshgrid()*.
14. Write a Python Programm to Plot a circle using the *polar()* function.

Section D
(Answer any One, 6 Marks each)

15. Explain Conditionals and Loops in Python in detail with Examples.
16. Write Python Programm to Plot the following.
    (a) Ellipse.
    (b) Astroid.
    (c) Spirals of Archimedes.

KANNUR UNIVERSITY MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

OPEN COURSE

5D01MAT-Business Mathematics

Time: Two Hours Maximum Marks: 20

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

Fill in the blanks:

1. $\lim_{x\to 5}\frac{x^2-25}{x-5}$ = --------.
2. $\frac{d(a^x)}{dx}$ = ------------
3. For a local maxima or minima $\frac{dy}{dx}=$----------
4. $\int e^{8x}dx=$------------

Section B

Answer any 6 questions from among the questions 5 to 13. These questions carry 2 marks each.

5. Draw the graph of $y=|x|$
6. Find the value of $\lim_{x\to 1}\left(\frac{x^3-1}{x^2-1}\right)$
7. Evaluate $\lim_{n\to\infty}\left[\frac{1}{n^3}\left(1^2+2^2+3^2+\ldots+n^2\right)\right]$
8. Find the derivative with respect to x if $f(x)=x^5+\frac{1}{2x}+21$
9. If $y=x^x$, find $\frac{dy}{dx}$
10. Using the product formula find $\frac{dy}{dx}$ if $y=x^2e^{2x}$

11. Differentiate with respect to x. if $f(x)=\frac{x^3+3x^2-4}{x}$

12. Integrate $\int\sqrt{3x^2-4}\;\;6x\;dx$

13. Evaluate $\int\frac{1}{x^{25}}dx$

Section C

Answer any* one *question from among the questions* 14 & 15. *These questions carry* 4 *marks each.

14. Show that the height of a closed cylinder of given surface and maximum volume is equal to the diameter of its base?

15. Evaluate $\lim_{x\to\infty}\frac{(x+1)(2x+3)}{(x+2)(3x+4)}$

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KANNUR UNIVERSITY MODEL QUESTION PAPER
V SEMESTER B Sc DEGREE EXAMINATION
OPEN COURSE IN MATHEMATICS
5D 02 MAT: ASTRONOMY

Time: 2 Hours **Max.Marks:20**

Section A
Answer the following 4 questions.Each carry 1 mark.

1. Define polar triangle.
2. What is meant by diurnal motion.
3. Define ecliptic.
4. What are latitude circles?

Section B
Answer any 6 questions. Each carry 2 marks.

5. In the spherical triangle ABC prove that $cos\ a = cos\ b\ cos\ c + sin\ b\ sin\ c\ cos\ A$.
6. Explain Napier's rules.
7. Find the values of $sin\frac{A}{2}, cos\frac{A}{2}$.
8. Explain briefly equinoxes and solstices.
9. Find the relation between Right Ascension and longitude of the sun.
10. Write short note on circumpolar star.
11. Explain the phenomenon of perpetual day.
12. Assuming the earth to be a sphere, show how its radius can be calculated.
13. What are the different zones of earth?

Section C
Answer any 1 question. Mark 4.

14. a) In the spherical triangle ABC prove that $cos\ b\ cosC = sin\ b\ cot\ a - sin\ C\ cot\ A$.
b) Prove that the latitude of a place is equal to the altitude of the celestial pole.

15. a) Find the condition that a star is circumpolar.
b)Find the conditions for perpetual day and night.

KANNUR UNIVERSITY MODEL QUESTION PAPER

FIFTH SEMESTER B.Sc. DEGREE EXAMINATION

OPEN COURSE

5D 03 MAT: Quantitative Arithmetic and Reasoning

Time: Two Hours Maximum Marks: 20

Section A

All the first* 4 *questions are compulsory. They carry* 1 *mark each.

Fill in the blanks:

1. Fill the missing numbers : $\frac{14}{21} = \frac{\_}{3} = \frac{6}{\square}$

2. Cost of 6 glasses of juice is Rs. 210. What will be the cost of 4 glasses of juice ?

3. Compute $\frac{7!}{5!}$

4. Which one is leap year ? 1700, 1980, 2100, 2200

Section B

Answer any* 6 *questions from among the questions* 5 *to* 13. *These questions carry* 2 *marks each.

5. At present the age of **A** is 15 and that of **B** is 18. After how many years the sum of their age will become 45?

6. There are 256 students in a school and the ratio of boys and girls is 9:7. Find the number of girls.

7. What will be the angle between the hour hand and minute hand of a clock if the time is 9:30 am

8. If a radio is purchased for Rs. 490 and sold for Rs. 465.50 then find the loss percentage.

9. 25 men can do a piece of work in 24 days. How many men would be required to do the same work in 10 days?

10. How many minutes does Aditya take to cover a distance of 400m, if he runs at a speed of 20km/hr ?

11. How many 4 digit numbers are there, with no digit repeated.

12. A man can raw upstream at 7km/hr. Find man’s rate in still water and the rate of current.

13. At a point 200ft, in a horizontal line, from the foot of a tower, the angle of elevation of the top of the tower is observed to be 60^0 . Find the height of the tower.

Section C

Answer any* one *question from among the questions* 14 & 15**. ***These questions carry* 4 *marks each.

14. Of the three numbers, the first is twice the second number and the second is thrice the third.
    If the average of these three numbers is 10, find them.
15. What was the day of the week on 15^{th} August 1947 ?

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KANNUR UNIVERSITY MODEL QUESTION PAPER
Fifth SEMESTER B.Sc. DEGREE EXAMINATION
Mathematics (Open Course)
5D 04 MAT: Linear Programming

Time: Two hours **Max marks:20**

Section A
Fill in the blanks. All the first 4 questions are compulsory. They carry 1 mark each

1. Define optimum and feasible solution of a general L.P.P.
2. Define the term loop associated with a transportation problem.
3. Define balanced and unbalanced transportation problem.
4. Give a necessary and sufficient condition for the existence of a feasible solution to the general T.P.

Section B
Answer any 6 questions from among the questions 5 to 13. These questions carry 2 marks each.

5. Define basic solution to a system of equations.
6. Explain the canonical form of L.P.P
7. Formulate dual of the following L.P.P.
Minimize $z = 4x_1 + 6x_2 + 18x_3$ subject to
$x_1 + 3x_2 \geq 3$
$x_2 + 2x_3 \geq 5$ and $x_j \geq 0, j = 1, 2, 3$
8. Solve graphically the following L.P.P.
Maximize $z = x_1 + 2x_2 + 3x_3$ subject to the constraints
$x_1 + 2x_2 + 3x_3 \leq 10;\quad x_1 + x_2 \leq 5;\quad x_1, x_2, x_3 \geq 0$
9. Find an initial basic feasible solution to the following T.P. using matrix minima method.

	D_1	D_2	D_3	D_4	Supply
S_1	3	7	6	4	5
S_2	2	4	3	2	2
S_3	4	3	8	5	3
Demand	3	3	2	2	

10. Find an initial basic feasible solution to the following T.P. using Vogel's approximation method.

	M_1	M_2	M_3	M_4	Supply
F_1	4	6	8	13	500
F_2	13	11	10	8	700
F_3	14	4	10	13	300
F_4	9	11	13	3	500
Demand	250	350	1,050	200	

11. Solve the following minimal assignment problem

		A	B	C
D				
I	1	4	6	3
II	9	7	10	9
III	4	5	11	7
IV	8	7	8	5

.

12. Explain the various steps of the North-West corner rule.

13. Briefly explain degeneracy in transportation problem

Section C

Answer any 1 question from the following questions. These questions carry 4 marks each

14. Solve using simplex method
$z = 3x_1 + 2x_2$ subject to the constraints
$-2x_1 + x_2 = 1; \quad x_1 \leq 2; \quad x_1 + x_2, \leq 3, x_1, x_2 \geq 0$

15. Given $x_{13} = 50$ units, $x_{14} = 20$ units, $x_{21} = 55$ units, $x_{31} = 30$ units, $x_{32} = 35$ units and $x_{34} = 25$ units. Is it an optimal solution to the transportation problem

					Available units
	6	1	9	3	70
	11	5	2	8	55
	10	12	4	7	90
Required units	85	35	50	45	

If not, modify it to obtain a better feasible solution.

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

1C01MAT-PH: Mathematics for Physics - I

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. The derivative of $\cosh^{-1} x$ is …………..
2. State Rolle's Theorem.
3. Find $\lim_{(x,\, y)\to(0,\, 0)} \dfrac{x^2 - 4xy}{\sqrt{x} - 2\sqrt{y}}$.
4. True or False: The polar coordinates $\left(2, \dfrac{7\pi}{6}\right)$ and $\left(-2, -\dfrac{\pi}{6}\right)$ represent the same point .

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. If $x^y y^x = 1$, find $\dfrac{dy}{dx}$.
6. If $x = a(\cos t + t\sin t)$, $y = a(\sin t - t\cos t)$, find $\dfrac{d^2y}{dx^2}$.
7. Expand $\cos x$ by Maclaurin's series.
8. Verify Lagrange's mean value theorem for the function

$$f(x) = e^x \quad \text{on} \ [0, 1].$$

9. Discuss the graph of $y = \sinh x$.
10. Find $\lim_{x\to 0} \dfrac{(1+x)^n - 1}{x}$.
11. Verify that $\dfrac{\partial^3 u}{\partial y \partial x^2} = \dfrac{\partial^3 u}{\partial x^2 \partial y}$, where $u = y^2 e^x + x^2 y^3$.
12. If $v = f\left(\frac{x}{z}, \frac{y}{z}\right)$, show that $x\dfrac{\partial v}{\partial x} + y\dfrac{\partial v}{\partial y} + z\dfrac{\partial v}{\partial z} = 0$.
13. If A, B, C are the angles of a triangle such that $\sin^2 A + \sin^2 B + \sin^2 C = K$, where K is a constant, prove that $\dfrac{dA}{dB} = \dfrac{\tan B - \tan C}{\tan C - \tan A}$.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $y = \cos(m\sin^{-1}x)$ show that $(1-x^2)y_{n-2} - (2n+1)xy_{n-1} + (m^2-n^2)y_n = 0.$

15. Expand $e^{a\sin^{-1}x}$ in powers of x by Maclaurin's Theorem.

16. Use Cauchy's Mean Value Theorem to evaluate $\lim\limits_{x\to 1} \dfrac{\cos\frac{\pi x}{2}}{\log\frac{1}{x}}.$

17. If $u = \sin^{-1}\left(\dfrac{x^3-y^3}{x+y}\right)$, show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2\tan u.$

18. Find the curvature at the point $\left(\dfrac{3a}{2}, \dfrac{3a}{2}\right)$ on the curve $x^3 + y^3 = 3axy.$

19. Show, by changing to Cartesian coordinates, that $r = 8\sin\theta$ is a circle and $r = \dfrac{2}{1-\cos\theta}$ is a parabola.

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Use Taylor's theorem to prove that $\tan^{-1}(x+h) = \tan^{-1}x + h\sin x \cdot \dfrac{\sin z}{1}$

$$-(h\sin z)^2\frac{\sin 2z}{2} + (h\sin z)^3\frac{\sin 3z}{3},$$

where $z = \cot^{-1}x.$

21. ***Find*** $\lim\limits_{x\to 0}\dfrac{e^x - e^{-x} - 2\log(1+x)}{x\sin x}.$

22. Find the evolute of the curve $x = a\cos^3 t,\ y = a\sin^3 t.$

23. Translate the equation $\rho = 6\cos\phi$ into Cartesian and cylindrical equations .

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

2C02MAT-PH: Mathematics for Physics - II

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give the reduction formula for $\int \sin^n x\,dx$
2. The volume obtained by revolving about the X-axis the arc of the curve $y = f(x)$, intercepted between the points whose abscissae are a, b is ………………………
3. The rank of the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ is ……..
4. Give an example of a skew symmetric matrix.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Obtain the value of $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}}\,dx$
6. Evaluate $\int \operatorname{cosec}^5 x\,dx$
7. Find the area bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.
8. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.
9. Evaluate $\int_0^1 \int_0^2 \int_0^2 x^2 yz\ dz\ dy\ dx \cdot$
10. Evaluate $\iint_R \left(x^2 + y^2\right) dx\,dy$ over the region R in which $x \ge 0;\ y \ge 0$ and $x + y \le 1$.

11. Find a 2×2 matrix $A\neq 0$ such that $A^2=0$.

12. Verify Cayley Hamilton theorem for the matrix $A=\begin{bmatrix}1 & 4\\ 2 & 3\end{bmatrix}$.

13. Prove that a matrix A and its transpose A^T have the same characteristic roots.

Section C

Answer any 4 questions from among the questions 14 to 19.

These questions carry 3 marks each.

14. Find the whole length of the astroid $x^{2/3}+y^{2/3}=a^{2/3}$.

15. Find the volume of the solid obtained by revolving the lemniscate $r^2=a^2\cos 2\theta$ about the initial line.

16. Solve the following system of equations:

$$\begin{array}{rcrcrcr} x & + & y & + & z & = & 9\\ 2x & + & 5y & + & 7z & = & 52\\ 2x & + & y & - & z & = & 0\end{array}$$

17. If $A\neq 0$ and $B\neq 0$ are $n\times n$ matrices such that $AB=0$ then prove that both A and B have rank less than n.

18. Prove that the eigen values of a triangular matrix are the same as its diagonal elements.

19. Using Cayley-Hamilton theorem find the inverse of

$$A=\begin{bmatrix}1 & 2\\ 3 & 4\end{bmatrix}.$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Obtain the intrinsic equation of the cycloid

$$x=a(t+\sin t),\quad y=a(1-\cos t),$$

the fixed point being the origin.

21. Change the order of integration and hence evaluate the double integral $\int_0^1\int_x^{2-x}\frac{x}{y}dydx$

22. Investigate for what values of λ and μ the simultaneous equations

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

have

(i) no solution ;

(ii) a unique solution ; and

an infinite number of solutions.

23. Find the eigen vectors of the matrix $A = \begin{bmatrix} 10 & 3 \\ 4 & 6 \end{bmatrix}$.

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

3C03MAT-PH: Mathematics for Physics - III

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Obtain the differential equation associated with the primitive $y = Ax^2 + Bx + C$.
2. The value of $\mathcal{L}[t]$, where $\mathcal{L}$ denotes the Laplace transform operator, is ……………..
3. The primitive period of $\sin \pi x$ is …………..
4. Give three dimensional Laplace equation.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky$; $y(0) = 0$, where a, b, k are constants.
6. Show that the equation

   $\cos x(\cos x - \sin a \sin y)dx + \cos y(\cos y - \sin a \sin x)dy = 0$ is exact and solve it.
7. Solve the linear differential equation $y' - y = e^{2x}$.
8. Solve the initial value problem

   $$y'' - y' - 2y = 0, \quad y(0) = 4, \quad y'(0) = 1.$$
9. Find a general solution of the following differential equation

   $$(D^2 + 2D + 2)y = 0 \ ,$$

   where D is the differential operator.
10. Solve $x^2 y'' - 2.5xy' - 2y = 0$.
11. Using Linearity Theorem, obtain the value of $L(\cos at)$.
12. Find the inverse Laplace transform of $\frac{1}{s^2}\left(\frac{s+1}{s^2+a}\right)$.

13. Show that the functions

$$u = x^2 - y^2 \quad \text{and} \quad u = e^x \cos y,$$

are solutions of the two dimensional Laplace equation.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Solve $x\dfrac{dy}{dx} + y = xy^3$.

15. Solve the nonhomogeneous equation

$$y'' - y' - 2y = 10\cos x.$$

16. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

17. Find the Fourier series of the function

$$f(x) = \begin{cases} x + x^2 & -\pi < x < \pi \\ \pi^2 & \text{when } x = \pm\pi \end{cases}$$

Deduce that $1 + \dfrac{1}{2^2} + \dfrac{1}{3^2} + \ldots = \dfrac{\pi^2}{6}$.

18. Solve the partial differential equation $u_y + 2\,y\,u = 0$, where u is a function of two variables x and y.

19. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x, \;\; z = x + y)$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Find the orthogonal trajectory of the family of circles $(x - c)^2 + y^2 = c^2$.

21. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x.$$

22. Applying Laplace transform, solve the initial value problem $y'' + 4y' + 3y = 0$, given $y(0)=3$, $y'(0) = 1$.

23. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \quad \text{for} \quad x \in [0, \pi]$$

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

4C04MAT-PH: Mathematics for Physics - IV

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give an example of a scalar field.
2. Define line integral.
3. State Intermediate Value Theorem.
4. Give the Newton-Raphson iteration formula.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Show that the derivative of a vector function $\mathbf{v}(t)$ of constant length is either the zero vector or is perpendicular to $\mathbf{v}(t)$.

6. Find a parametric representation of the straight line through the point A in the direction of a vector $\mathbf{b}$ where

$$A:(4, 2, 0),\ \mathbf{b} = \mathbf{i} + \mathbf{j}$$

7. Find the constants a, b, c so that

$$\mathbf{v} = (x + 2y + az)\,\mathbf{i} + (bx - 3y - z)\,\mathbf{j} + (4x + cy + 2z)\,\mathbf{k}$$

is irrotational.

8. Evaluate $\int_C \mathbf{F}.d\mathbf{r}$, where $\mathbf{F} = (x^2 + y^2)\,\mathbf{i} - 2\,xy\,\mathbf{j}$, and the curve C is the rectangle in the xy plane bounded by $x = 0,\ \ x = a,\ \ y = 0,\ \ y = b$.

9. Evaluate the integral

$$I = \int_C (3x^2dx + 2yzdy + y^2dz)$$

from $A:(0,1,2)$ to $B:(1,-1,7)$ by showing that $\mathbf{F}$ has a potential

10. Evaluate the Flux Integral $\iint_S \mathbf{F}\cdot\mathbf{n}\,dA$ for the following data.

$$\mathbf{F} = [3x^2,\ y^2,\ 0],\ \ S:\mathbf{r} = [u,\ v,\ 2u + 3v],\ \ 0 \le u \le 2, -1 \le u \le 1$$

11. Prove that

$$hD = \log(1+\Delta) = -\log(1-\nabla) = \sinh^{-1}(\mu\delta).$$

12. Using Taylor series, solve $y' = x - y^2$, $y(0)=1$. Also find $y(0.1)$ correct to four decimal places.

13. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

Also find $y(2.05)$ and $y(3.18)$ correct to four places of decimal.

Section C

Answer any 4 questions from among the questions 14 to 19.

These questions carry 3 marks each.

14. If $f(x, y, z)$ is a twice differentiable scalar function, then show that div (grad f) = $\Delta^2 f$.

15. Evaluate the surface integral $\iint_S \mathbf{F} \cdot \mathbf{n}\, dA$ by the divergence theorem for the following data:

$\mathbf{F} = [x^2, 0, z^2]$, S the surface of the box given by the inequalities $|x| \le 1, |y| \le 3, |z| \le 2.$

16. Solve $x^3 - 9x + 1 = 0$ for a root between $x = 2$ and $x = 4$, by bisection method.

17. Find the cubic polynomial which takes the following values; $f(1) = 24, f(3) = 120, f(5) = 336,$ and $f(7) = 720$. Hence, or otherwise, obtain the value of $f(8)$.

18. From the following table of values of x and y, obtain $\frac{dy}{dx}$ for $x = 1.2$:

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

19. Use Euler's method with $h = 0.1$ to solve the initial value problem

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 0 \text{ in the range } 0 \le x \le 0.5.$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Prove that curl (curl $\mathbf{F}$) = grad div $\mathbf{F} - \nabla^2 \mathbf{F}$.

21. Verify Stokes's theorem, for $\mathbf{F} = [y, z, x] = y\mathbf{i} + z\mathbf{j} + x\mathbf{k}$ and S the paraboloid

$$z = f(x, y) = 1 - (x^2 + y^2), \qquad z \geq 0$$

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

1C01MAT-CH: Mathematics for Chemistry - I

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. The derivative of $\tanh^{-1} x$ is …………..
2. State Maclaurin's Theorem.
3. Find $\lim\limits_{(x,\, y)\to(0,\, 0)} \dfrac{x}{x+y+1}$.
4. Represent the polar coordinate $\left(2, \dfrac{7\pi}{6}\right)$ in polar graph.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. If $x^y y^x = 1$, find $\dfrac{dy}{dx}$.
6. If $x = 32(\cos t + t\sin t)$, $y = 32(\sin t - t\cos t)$, find $\dfrac{d^2 y}{dx^2}$.
7. Expand $\sin x$ by Maclaurin's series.
8. Verify Lagrange's mean value theorem for the function

$$f(x) = e^x \quad \text{on } [0, 1].$$

9. Discuss the graph of $y = \cosh x$.
10. Find $\lim\limits_{x\to 0} \dfrac{(1+x)^n - 1}{x^2}$.
11. Verify that $\dfrac{\partial^3 u}{\partial y \partial x^2} = \dfrac{\partial^3 u}{\partial x^2 \partial y}$, where $u = 100x^3y^2 + x^2y^3$.
12. If $v = f\left(\frac{x}{z}, \frac{y}{z}\right)$, show that $x\dfrac{\partial v}{\partial x} + y\dfrac{\partial v}{\partial y} + z\dfrac{\partial v}{\partial z} = 0$.
13. If A, B, C are the angles of a triangle such that $\sin^2 A + \sin^2 B + \sin^2 C = K$,

    where K is a constant, prove that $\dfrac{dA}{dB} = \dfrac{\tan B - \tan C}{\tan C - \tan A}$.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $y = \cos(m\sin^{-1} x)$ show that $(1-x^2)y_{n-2} - (2n+1)xy_{n-1} + (m^2 - n^2)y_n = 0.$

15. Expand $e^{a\sin^{-1} x}$ in powers of x by Maclaurin's Theorem.

16. Use Cauchy's Mean Value Theorem to evaluate $\lim\limits_{x\to 1} \dfrac{\cos\frac{\pi x}{2}}{\log\frac{1}{x}}$.

17. If $u = \sin^{-1}\left(\dfrac{x^3 - y^3}{x+y}\right)$, show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2\tan u.$

18. Find the curvature at the point $(x,\ y)$ on the curve $x^3 + y^3 = 3axy.$

19. Show, by changing to Cartesian coordinates, that $r = 8\sin\theta$ is a circle and $r = \dfrac{2}{1-\cos\theta}$ is a parabola.

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Use Taylor's theorem to prove that $\tan^{-1}(x+h) = \tan^{-1} x + h\sin x \cdot \dfrac{\sin z}{1}$

$$-(h\sin z)^2\frac{\sin 2z}{2} + (h\sin z)^3\frac{\sin 3z}{3},$$

where $z = \cot^{-1} x.$

21. ***Find*** $\lim\limits_{x\to 0}\dfrac{e^x - e^{-x} - 2\log(1+x)}{x\sin x}.$

22. Find the evolute of the curve $x = a\cos^3 t,\ \ y = a\sin^3 t.$

23. Translate the equation $\rho = 6\cos\phi$ into Cartesian and cylindrical equations .

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SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

2C02MAT-CH: Mathematics for Chemistry - II

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give the reduction formula for $\int \cos^n x\, dx$
2. The volume obtained by revolving about the y-axis the arc of the curve $x = f(y)$, intercepted between the points whose y-coordinates are a, b is ………………
3. The rank of the matrix $A = \begin{bmatrix} 0 & 0 \\ 0 & \sqrt{3} \end{bmatrix}$ is ……..
4. Give an example of a symmetric matrix.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Obtain the value of $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}} dx$
6. Evaluate $\int \sec^5 x\, dx$
7. Find the area bounded by the ellipse $\frac{x^2}{100} + \frac{y^2}{36} = 1.$
8. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.
9. Evaluate $\int_0^1 \int_0^2 \int_0^2 x^2 yz\; dz\; dy\; dx \cdot$
10. Evaluate $\iint_R 32\left(x^2 + y^2\right) dx\, dy$ over the region R in which $x \geq 0;\ y \geq 0$ and $x + y \leq 1.$
11. Find a 2×2 matrix $A \neq 0$ such that $A^2 = 0.$

12. Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 25 \\ 0 & 3 \end{bmatrix}$.

13. Prove that a matrix A and its transpose A^T have the same characteristic roots.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Find the whole length of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$.

15. Find the volume of the solid obtained by revolving the lemniscate $r^2 = a^2 \cos 2\theta$ about the initial line.

16. Solve the following system of equations:

$$\begin{array}{rcrcrcr} x & + & y & + & z & = & 3 \\ 2x & + & 5y & + & 7z & = & 14 \\ 2x & + & y & - & z & = & 2 \end{array}$$

17. If $A \neq 0$ and $B \neq 0$ are $n \times n$ matrices such that $AB = 0$ then prove that both A and B have rank less than n.

18. Prove that the eigen values of a triangular matrix are the same as its diagonal elements.

19. Using Cayley-Hamilton theorem find the inverse of

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}.$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Obtain the intrinsic equation of the cycloid

$$x = a(t + \sin t), \quad y = a(1 - \cos t),$$

the fixed point being the origin.

21. Change the order of integration and hence evaluate the double integral $\int_0^1 \int_x^{2-x} \frac{x}{y} dy dx$

22. Investigate for what values of λ and μ the simultaneous equations

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

have

(iii) no solution ;

(iv) a unique solution ; and

an infinite number of solutions.

23. Find the eigen vectors of the matrix $A = \begin{bmatrix} 10 & 3 \\ 4 & 6 \end{bmatrix}$.

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

3C03MAT-CH: Mathematics for Chemistry - III

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Examine that $y = e^{5x}$ is a solution of the differential equation $\frac{dy}{dx} = 5y$.
2. The value of $\mathcal{L}[t]$, where $\mathcal{L}$ denotes the Laplace transform operator, is ……………..
3. The primitive period of $\cos\frac{\pi}{2}x$ is …………..
4. Give three dimensional Laplace equation.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky$; $y(0) = 0$, where a, b, k are constants.
6. Show that the equation

   $\cos x(\cos x - \sin a \sin y)\,dx + \cos y(\cos y - \sin a \sin x)\,dy = 0$ is exact and solve it.
7. Solve the linear differential equation $y' - y = e^{2x}$.
8. Solve the initial value problem

   $$y'' - y' - 2y = 0, \quad y(0) = 4, \quad y'(0) = 1.$$
9. Find a general solution of the following differential equation

   $$(D^2 + 2D + 2)y = 0 ,$$

   where D is the differential operator.

10. Solve $x^2 y'' - 2.5xy' - 2y = 0$.

11. Using Linearity Theorem, obtain the value of $L(\sin at)$.

12. Find the inverse Laplace transform of $\frac{1}{s}\left(\frac{s+1}{s^2+a}\right)$.

13. Show that the functions

$$u = x^2 - y^2 \quad \text{and} \quad u = e^x \sin y,$$

are solutions of the two dimensional Laplace equation.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Solve $x\frac{dy}{dx} + y = xy^3$.

15. Solve the nonhomogeneous equation

$$y'' - y' - 2y = 10\cos x.$$

16. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

17. Find the Fourier series of the function

$$f(x) = \begin{cases} x + x^2 & -\pi < x < \pi \\ \pi^2 & \text{when } x = \pm\pi \end{cases}$$

Deduce that $1 + \frac{1}{2^2} + \frac{1}{3^2} + \ldots = \frac{\pi^2}{6}$.

18. Solve the partial differential equation $u_y + 2yu = 0$, where u is a function of two variables x and y.

19. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x, \quad z = x + y)$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Find the orthogonal trajectory of the family of circles $(x-c)^2 + y^2 = c^2$.

21. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x .$$

22. Applying Laplace transform, solve the initial value problem $y'' + 4y' + 3y = 0$, given $y(0)=3$, $y'(0) = 1$.

23. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \quad \text{for} \quad x \in [0, \pi]$$

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

4C04MAT-CH: Mathematics for Chemistry - IV

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. State True/False: Force is a scalar field.
2. Define line integral.
3. State Intermediate Value Theorem.
4. Give the Newton-Raphson iteration formula.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Show that the derivative of a vector function $\mathbf{v}(t)$ of constant length is either the zero vector or is perpendicular to $\mathbf{v}(t)$.

6. Find a parametric representation of the straight line through the point A in the direction of a vector $\mathbf{b}$ where

$$A:(4,\ 2,\ 0),\ \ \mathbf{b} = \mathbf{i} + \mathbf{j}$$

7. Find the constants a, b, c so that

$$\mathbf{v} = (x + 2y + az)\,\mathbf{i} + (bx - 3y - z)\,\mathbf{j} + (4x + cy + 2z)\,\mathbf{k}$$

is irrotational.

8. Evaluate $\oint_C \mathbf{F}.d\mathbf{r}$, where $\mathbf{F} = (x^2 + y^2)\,\mathbf{i} - 2\,xy\,\mathbf{j}$, and the curve C is the rectangle in the xy plane bounded by $x = 0,\ \ x = a,\ \ y = 0,\ \ y = b$.

9. Evaluate the integral

$$I = \int_C (3x^2 dx + 2yzdy + y^2 dz)$$

from $A:(0,1,2)$ to $B:(1,-1,7)$ by showing that $\mathbf{F}$ has a potential

10. Evaluate the Flux Integral $\iint_S \mathbf{F}\cdot\mathbf{n}\,dA$ for the following data.

$$\mathbf{F} = [3x^2,\ y^2,\ 0],\ \ S:\mathbf{r} = [u,\ v,\ 2u + 3v],\ \ 0 \le u \le 2,\ -1 \le u \le 1$$

11. Prove that

$$hD = \log(1+\Delta) = -\log(1-\nabla) = \sinh^{-1}(\mu\delta).$$

12. Using Taylor series, solve $y' = x - y^2$, $y(0) = 1$. Also find $y(0.1)$ correct to four decimal places.

13. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

Also find $y(2.05)$ and $y(3.18)$ correct to four places of decimal.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $f(x, y, z)$ is a twice differentiable scalar function, then show that div (grad f) = $\Delta^2 f$.

15. Evaluate the surface integral $\iint_S \mathbf{F}\cdot\mathbf{n}\, dA$ by the divergence theorem for the following data:

$\mathbf{F} = [x^2, 0, z^2]$, S the surface of the box given by the inequalities $|x| \le 1, |y| \le 3, |z| \le 2.$

16. Solve $x^3 - 9x + 1 = 0$ for the root between $x = 2$ and $x = 4$, by bisection method.

17. Find the cubic polynomial which takes the following values; $f(1) = 24, f(3) = 120, f(5) = 336,$ and $f(7) = 720$. Hence, or otherwise, obtain the value of $f(8)$.

18. From the following table of values of x and y, obtain $\frac{dy}{dx}$ for $x = 1.2$:

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

19. Use Euler's method with $h = 0.1$ to solve the initial value problem

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 0 \text{ in the range } 0 \le x \le 0.5.$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Prove that curl (curl $\mathbf{F}$) = grad div $\mathbf{F} - \nabla^2 \mathbf{F}$.

21. Verify Stokes's theorem, for $\mathbf{F} = [y, z, x] = y\mathbf{i} + z\mathbf{j} + x\mathbf{k}$ and S the paraboloid

    $z = f(x, y) = 1 - (x^2 + y^2), \qquad z \geq 0$

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

1C01MAT-ST: Mathematics for Statistics-I

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. The derivative of $\operatorname{sech}^{-1} x$ is …………..
2. State Maclaurin's Theorem.
3. Find $\lim\limits_{(x,\, y)\to(0,\, 0)} \dfrac{x+y+1}{x^2-y^2+1}$.
4. Represent the polar coordinate $(3,\ 0)$ in polar graph.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. If $x^y y^x = 1$, find $\dfrac{dy}{dx}$.
6. If $x = 32(\cos t + t\sin t)$, $y = 32(\sin t - t\cos t)$, find $\dfrac{d^2y}{dx^2}$.
7. Expand $\sin x$ by Maclaurin's series.
8. Verify Lagrange's mean value theorem for the function

$$f(x) = e^x \quad \text{on } [0, 1].$$

9. Discuss the graph of $y = \cosh x$.
10. Find $\lim\limits_{x\to 0} \dfrac{(1+x)^n - 1}{x^2}$.
11. Verify that $\dfrac{\partial^3 u}{\partial y \partial x^2} = \dfrac{\partial^3 u}{\partial x^2 \partial y}$, where $u = 100x^3y^2 + x^2y^3$.
12. If $v = f\left(\frac{x}{z}, \frac{y}{z}\right)$, show that $x\dfrac{\partial v}{\partial x} + y\dfrac{\partial v}{\partial y} + z\dfrac{\partial v}{\partial z} = 0$.
13. If A, B, C are the angles of a triangle such that $\sin^2 A + \sin^2 B + \sin^2 C = K$,

    where K is a constant, prove that $\dfrac{dA}{dB} = \dfrac{\tan B - \tan C}{\tan C - \tan A}$.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $y=\cos(m\sin^{-1}x)$ show that $(1-x^2)y_{n-2}-(2n+1)xy_{n-1}+(m^2-n^2)y_n=0.$

15. Expand $e^{a\sin^{1}x}$ in powers of x by Maclaurin's Theorem.

16. Use Cauchy's Mean Value Theorem to evaluate $\lim\limits_{x\to 1}\dfrac{\cos\frac{\pi x}{2}}{\log\frac{1}{x}}$.

17. If $u=\sin^{-1}\left(\dfrac{x^3-y^3}{x+y}\right)$, show that $x\dfrac{\partial u}{\partial x}+y\dfrac{\partial u}{\partial y}=2\tan u.$

18. Find the curvature at the point $(x,\ y)$ on the curve $x^3+y^3=3axy.$

19. Show, by changing to Cartesian coordinates, that $r=8\sin\theta$ is a circle and $r=\dfrac{2}{1-\cos\theta}$ is a parabola.

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Use Taylor's theorem to prove that $\tan^{-1}(x+h)=\tan^{-1}x+h\sin x\cdot\dfrac{\sin z}{1}$

$$-(h\sin z)^2\frac{\sin 2z}{2}+(h\sin z)^3\frac{\sin 3z}{3},$$

where $z=\cot^{-1}x.$

21. Find $\lim\limits_{x\to 0}\dfrac{e^x-e^{-x}-2\log(1+x)}{x\sin x}$.

22. Find the evolute of the curve $x=a\cos^3 t,\ \ y=a\sin^3 t.$

23. Translate the equation $\rho=6\cos\phi$ into Cartesian and cylindrical equations

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SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

2C02 MAT-ST: Mathematics for Statistics - II

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give the reduction formula for $\int \tan^n x\,dx$

2. The volume obtained by revolving about the y-axis the arc of the curve $x = f(y)$, intercepted between the points whose y-coordinates are a, b is ………………

3. The rank of the matrix $A = \begin{bmatrix} 0 & 0 \\ 0 & \sqrt{3} \end{bmatrix}$ is ……..

4. Give an example of a symmetric matrix.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Obtain the value of $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}}\,dx$

6. Evaluate $\int \sec^9 x\,dx$

7. Find the area bounded by the ellipse $\frac{x^2}{100} + \frac{y^2}{36} = 1$.

8. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.

9. Evaluate $\int_0^1 \int_0^2 \int_0^2 x^2 yz\ dz\ dy\ dx \cdot$

10. Evaluate $\iint_R 32\left(x^2 + y^2\right)dx\,dy$ over the region R in which $x \geq 0$; $y \geq 0$ and $x + y \leq 1$.

11. Find a 2×2 matrix $A \neq 0$ such that $A^2 = 0$.

12. Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 25 \\ 0 & 3 \end{bmatrix}$.

13. Prove that a matrix A and its transpose A^T have the same characteristic roots.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Find the whole length of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$.

15. Find the volume of the solid obtained by revolving the lemniscate $r^2 = a^2 \cos 2\theta$ about the initial line.

16. Solve the following system of equations:

$$\begin{array}{rcrcrcr} x & + & y & + & z & = & 3 \\ 2x & + & 5y & + & 7z & = & 14 \\ 2x & + & y & - & z & = & 2 \end{array}$$

17. If $A \neq 0$ and $B \neq 0$ are $n \times n$ matrices such that $AB = 0$ then prove that both A and B have rank less than n.

18. Prove that the eigen values of a triangular matrix are the same as its diagonal elements.

19. Using Cayley-Hamilton theorem find the inverse of

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}.$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Obtain the intrinsic equation of the cycloid

$$x = a(t + \sin t), \quad y = a(1 - \cos t),$$

the fixed point being the origin.

21. Change the order of integration and hence evaluate the double integral $\int_0^1 \int_x^{2-x} \frac{x}{y}\, dy\, dx$

22. Investigate for what values of λ and μ the simultaneous equations

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

have

(v) no solution ;

(vi) a unique solution ; and

an infinite number of solutions.

23. Find the eigen vectors of the matrix $A = \begin{bmatrix} 10 & 3 \\ 4 & 6 \end{bmatrix}$.

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

3C03MAT-ST: Mathematics for Statistics - III

Time: Three Hours　　　　　　　　　　　　　　　　Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Examine that $y = 100e^{\sqrt{2}x}$ is a solution of the differential equation $\frac{dy}{dx} = \sqrt{2}y$.
2. The value of $\mathcal{L}[t]$, where $\mathcal{L}$ denotes the Laplace transform operator, is ……………..
3. The primitive period of $\cos\frac{3\pi}{2}x$ is …………..
4. Give three dimensional Laplace equation.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky;\quad y(0) = 0,$ where a, b, k are constants.
6. Show that the equation

   $\cos x(\cos x - \sin a \sin y)\,dx + \cos y(\cos y - \sin a \sin x)\,dy = 0$ is exact and solve it.
7. Solve the linear differential equation $y' - y = e^{2x}$.
8. Solve the initial value problem

   $y'' - y' - 2y = 0,\quad y(0) = 4,\quad y'(0) = 1.$
9. Find a general solution of the following differential equation

   $(D^2 + 2D + 2)y = 0$,

   where D is the differential operator.
10. Solve $x^2y'' - 2.5xy' - 2y = 0.$
11. Using Linearity Theorem, obtain the value of $L(\sin at)$.
12. Find the inverse Laplace transform of $\frac{1}{s}\left(\frac{s+1}{s^2+a}\right)$.
13. Show that the functions $u = x^2 - y^2$ and $u = e^x \sin y$ are solutions of the two dimensional Laplace equation.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Solve $x\dfrac{dy}{dx} + y = xy^3$.

15. Solve the nonhomogeneous equation

    $y'' - y' - 2y = 10\cos x.$

16. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

17. Find the Fourier series of the function

$$f(x) = \begin{cases} x + x^2 & -\pi < x < \pi \\ \pi^2 & \text{when } x = \pm\pi \end{cases}$$

   Deduce that $1 + \dfrac{1}{2^2} + \dfrac{1}{3^2} + ... = \dfrac{\pi^2}{6}$.

18. Solve the partial differential equation $u_y + 2\,y\,u = 0$, where u is a function of two variables x and y.

19. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x, \quad z = x + y)$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Find the orthogonal trajectory of the family of circles $(x-c)^2 + y^2 = c^2$.

21. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x .$$

22. Applying Laplace transform, solve the initial value problem $y'' + 4y' + 3y = 0$, given $y(0)=3$, $y'(0) = 1$.

23. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \text{ for } x \in [0, \pi]$$

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

4C04 MAT-ST: Mathematics for Statistics - IV

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. State True/False: Speed is a scalar field.
2. Define curve integral.
3. State Intermediate Value Theorem.
4. Give the Newton-Raphson iteration formula.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Show that the derivative of a vector function $\mathbf{v}(t)$ of constant length is either the zero vector or is perpendicular to $\mathbf{v}(t)$.

6. Find a parametric representation of the straight line through the point A in the direction of a vector $\mathbf{b}$ where

$$A : (4,\ 2,\ 0),\ \ \mathbf{b} = \mathbf{i} + \mathbf{j}$$

7. Find the constants a, b, c so that

$$\mathbf{v} = (x + 2y + az)\,\mathbf{i} + (bx - 3y - z)\,\mathbf{j} + (4x + cy + 2z)\,\mathbf{k}$$

is irrotational.

8. Evaluate $\int_C \mathbf{F}.d\mathbf{r}$, where $\mathbf{F} = (x^2 + y^2)\,\mathbf{i} - 2\,xy\,\mathbf{j}$, and the curve C is the rectangle in the xy plane bounded by $x = 0,\ \ x = a,\ \ y = 0,\ \ y = b.$

9. Evaluate the integral

$$I = \int_C (3x^2 dx + 2yzdy + y^2 dz)$$

from $A : (0,1,2)$ to $B : (1,-1,7)$ by showing that $\mathbf{F}$ has a potential

10. Evaluate the Flux Integral $\iint_S \mathbf{F}\cdot\mathbf{n}\,dA$ for the following data.

$$\mathbf{F} = [3x^2,\ y^2,\ 0],\ \ S : \mathbf{r} = [u,\ v,\ 2u + 3v],\ \ 0 \le u \le 2,\ -1 \le u \le 1$$

11. Prove that

$$hD = \log(1+\Delta) = -\log(1-\nabla) = \sinh^{-1}(\mu\delta).$$

12. Using Taylor series, solve $y' = x - y^2$, $y(0) = 1$. Also find $y(0.1)$ correct to four decimal places.

13. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

Also find $y(2.05)$ and $y(3.18)$ correct to four places of decimal.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $f(x, y, z)$ is a twice differentiable scalar function, then show that div (grad f) = $\Delta^2 f$.

15. Evaluate the surface integral $\iint_S \mathbf{F} \cdot \mathbf{n}\, dA$ by the divergence theorem for the following data:

    $\mathbf{F} = [x^2, 0, z^2]$, S the surface of the box given by the inequalities $|x| \le 1, |y| \le 3, |z| \le 2.$

16. Solve $x^3 - 9x + 1 = 0$ for the root between $x = 2$ and $x = 4$, by bisection method.

17. Find the cubic polynomial which takes the following values; $f(1) = 24, f(3) = 120, f(5) = 336,$ and $f(7) = 720$. Hence, or otherwise, obtain the value of $f(8)$.

18. From the following table of values of x and y, obtain $\frac{dy}{dx}$ for $x = 1.2$:

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

19. Use Euler's method with $h = 0.1$ to solve the initial value problem

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 0 \text{ in the range } 0 \le x \le 0.5.$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Prove that curl (curl $\mathbf{F}$) = grad div $\mathbf{F} - \nabla^2 \mathbf{F}$.

21. Verify Stokes's theorem, for $\mathbf{F} = [y, z, x] = y\mathbf{i} + z\mathbf{j} + x\mathbf{k}$ and S the paraboloid

$$z = f(x, y) = 1 - (x^2 + y^2), \qquad z \geq 0$$

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

1C01MAT-CS: Mathematics for Computer Science - I

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. The derivative of $\operatorname{sech}^{-1} x$ is …………..
2. State Rolles's Theorem.
3. Find $\lim\limits_{(x,\,y)\to(1,\,1)} \dfrac{x+y+1}{x^2-y^2+1}$.
4. Represent the polar coordinate $(-2,\ 0)$ in polar graph.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. If $x^y y^x = 1$, find $\dfrac{dy}{dx}$.
6. If $x = 10(\cos t + t\sin t)$, $y = 10(\sin t - t\cos t)$, find $\dfrac{d^2y}{dx^2}$.
7. Expand $\sin x$ by Maclaurin's series.
8. Verify Lagrange's mean value theorem for the function

   $$f(x) = e^x \quad \text{on } [0, 1].$$
9. Discuss the graph of $y = \sinh x$.
10. Find $\lim\limits_{x\to 0} \dfrac{2(1+x)^n - 1}{x^2}$.
11. Verify that $\dfrac{\partial^3 u}{\partial y \partial x^2} = \dfrac{\partial^3 u}{\partial x^2 \partial y}$, where $u = \sqrt{3}x^3y^2 + x^2y^3$.
12. If $v = f\left(\frac{x}{z}, \frac{y}{z}\right)$, show that $x\dfrac{\partial v}{\partial x} + y\dfrac{\partial v}{\partial y} + z\dfrac{\partial v}{\partial z} = 0$.
13. If A, B, C are the angles of a triangle such that $\sin^2 A + \sin^2 B + \sin^2 C = K$,

    where K is a constant, prove that $\dfrac{dA}{dB} = \dfrac{\tan B - \tan C}{\tan C - \tan A}$.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $y = \cos(m\sin^{-1} x)$ show that $(1-x^2)y_{n-2} - (2n+1)xy_{n-1} + (m^2 - n^2)y_n = 0.$

15. Expand $e^{a\sin^{-1} x}$ in powers of x by Maclaurin's Theorem.

16. Use Cauchy's Mean Value Theorem to evaluate $\lim\limits_{x\to 1} \dfrac{\cos\frac{\pi x}{2}}{\log\frac{1}{x}}.$

17. If $u = \sin^{-1}\left(\dfrac{x^3 - y^3}{x+y}\right)$, show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2\tan u.$

18. Find the curvature at the point $(x,\ y)$ on the curve $x^3 + y^3 = 3axy.$

19. Show, by changing to Cartesian coordinates, that $r = 8\sin\theta$ is a circle and $r = \dfrac{2}{1-\cos\theta}$ is a parabola.

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Use Taylor's theorem to prove that
$$\tan^{-1}(x+h) = \tan^{-1} x + h\sin x \cdot \frac{\sin z}{1} - (h\sin z)^2 \frac{\sin 2z}{2} + (h\sin z)^3 \frac{\sin 3z}{3},$$
where $z = \cot^{-1} x.$

21. Find $\lim\limits_{x\to 0} \dfrac{e^x - e^{-x} - 2\log(1+x)}{x\sin x}.$

22. Find the evolute of the curve $x = a\cos^3 t,\ \ y = a\sin^3 t.$

23. Translate the equation $\rho = 100\cos\phi$ into Cartesian and cylindrical equations .

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

2C02 MAT-CS: Mathematics for Computer Science - II

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Give the reduction formula for $\int \sin^p x\,dx$
2. The volume obtained by revolving about the y-axis the arc of the curve $x = f(y)$, intercepted between the points whose y-coordinates are a, b is ………………
3. The rank of the matrix $A = \begin{bmatrix} 0 & 0 \\ 0 & \sqrt{3} \end{bmatrix}$ is ……..
4. Give an example of a symmetric matrix.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Obtain the value of $\int_0^a \frac{x^4}{\sqrt{a^2 - x^2}}\,dx$
6. Evaluate $\int \operatorname{cosec}^9 x\,dx$
7. Find the area bounded by the ellipse $\frac{x^2}{100} + \frac{y^2}{36} = 1$.
8. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.
9. Evaluate $\int_0^1 \int_0^2 \int_0^2 x^2 yz\;dz\;dy\;dx\cdot$
10. Evaluate $\iint_R 32\left(x^2 + y^2\right)dx\,dy$ over the region R in which $x \geq 0;\; y \geq 0$ and $x + y \leq 1$.

11. Find a 2×2 matrix $A \neq 0$ such that $A^2 = 0$.

12. Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 25 \\ 0 & 3 \end{bmatrix}$.

13. Prove that a matrix A and its transpose A^T have the same characteristic roots.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Find the whole length of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$.

15. Find the volume of the solid obtained by revolving the lemniscate $r^2 = a^2 \cos 2\theta$ about the initial line.

16. Solve the following system of equations:

$$\begin{array}{rcrcrcr} x & + & y & + & z & = & 3 \\ 2x & + & 5y & + & 7z & = & 14 \\ 2x & + & y & - & z & = & 2 \end{array}$$

17. If $A \neq 0$ and $B \neq 0$ are $n \times n$ matrices such that $AB = 0$ then prove that both A and B have rank less than n.

18. Prove that the eigen values of a triangular matrix are the same as its diagonal elements.

19. Using Cayley-Hamilton theorem find the inverse of

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}.$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Obtain the intrinsic equation of the cycloid

$$x = a(t + \sin t), \quad y = a(1 - \cos t),$$

the fixed point being the origin.

21. Change the order of integration and hence evaluate the double integral $\int_0^1 \int_x^{2-x} \frac{x}{y} dydx$

22. Investigate for what values of λ and μ the simultaneous equations

$$x + y + z = 6$$

$$x + 2y + 3z = 10$$

$$x + 2y + \lambda z = \mu$$

have

(vii) no solution ;

(viii) a unique solution ; and

an infinite number of solutions.

23. Find the eigen vectors of the matrix $A = \begin{bmatrix} 10 & 3 \\ 4 & 6 \end{bmatrix}$.

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

3C03 MAT-CS: Mathematics for Computer Science - III

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Examine that $y = e^{5x}$ is a solution of the differential equation $\dfrac{dy}{dx} = 5y$.
2. The value of $\mathcal{L}[t]$, where $\mathcal{L}$ denotes the Laplace transform operator, is ……………..
3. The primitive period of $\sin \dfrac{3\pi}{4} x$ is …………..
4. Give three dimensional Laplace equation.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky; \quad y(0) = 0,$ where a, b, k are constants.
6. Show that the equation

   $\cos x(\cos x - \sin a \sin y)\,dx + \cos y(\cos y - \sin a \sin x)\,dy = 0$ is exact and solve it.
7. Solve the linear differential equation $y' - y = e^{2x}$.
8. Solve the initial value problem

   $$y'' - y' - 2y = 0, \quad y(0) = 4, \quad y'(0) = 1.$$
9. Find a general solution of the following differential equation

   $$(D^2 + 2D + 2)y = 0 \ ,$$

   where D is the differential operator.
10. Solve $x^2 y'' - 2.5xy' - 2y = 0$.
11. Using Linearity Theorem, obtain the value of $L(\sin at)$.
12. Find the inverse Laplace transform of $\dfrac{1}{s}\left(\dfrac{s+1}{s^2 + a}\right)$.
13. Show that the functions

$$u = x^2 - y^2 \quad \text{and} \quad u = e^x \sin y\,,$$

are solutions of the two dimensional Laplace equation.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Solve $x\dfrac{dy}{dx} + y = xy^3$.

15. Solve the nonhomogeneous equation

    $y'' - y' - 2y = 10\cos x.$

16. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

17. Find the Fourier series of the function

$$f(x) = \begin{cases} x + x^2 & -\pi < x < \pi \\ \pi^2 & \text{when } x = \pm\pi \end{cases}$$

    Deduce that $1 + \dfrac{1}{2^2} + \dfrac{1}{3^2} + \ldots = \dfrac{\pi^2}{6}$.

18. Solve the partial differential equation $u_y + 2\,y\,u = 0$, where u is a function of two variables x and y.

19. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x,\ \ z = x + y)$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Find the orthogonal trajectory of the family of circles $(x - c)^2 + y^2 = c^2$.

21. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x\,.$$

22. Applying Laplace transform, solve the initial value problem $y'' + 4y' + 3y = 0$, given $y(0)=3,\ y'(0) = 1$.

23. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \quad \text{for} \quad x \in [0, \pi]$$

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

4C04 MAT-CS: Mathematics for Computer Science – IV

Time: Three Hours — Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. State True/False: Speed is a scalar field.
2. Define curve integral.
3. State Intermediate Value Theorem.
4. Give the Newton-Raphson iteration formula.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Show that the derivative of a vector function $\mathbf{v}(t)$ of constant length is either the zero vector or is perpendicular to $\mathbf{v}(t)$.

6. Find a parametric representation of the straight line through the point A in the direction of a vector $\mathbf{b}$ where

$$A:(4,\ 2,\ 0),\ \ \mathbf{b} = \mathbf{i} + \mathbf{j}$$

7. Find the constants a, b, c so that

$$\mathbf{v} = (x + 2y + az)\,\mathbf{i} + (bx - 3y - z)\,\mathbf{j} + (4x + cy + 2z)\,\mathbf{k}$$

is irrotational.

8. Evaluate $\int_C \mathbf{F}.d\mathbf{r}$, where $\mathbf{F} = (x^2 + y^2)\,\mathbf{i} - 2\,xy\,\mathbf{j}$, and the curve C is the rectangle in the xy plane bounded by $x = 0,\ \ x = a,\ \ y = 0,\ \ y = b$.

9. Evaluate the integral

$$I = \int_C (3x^2 dx + 2yzdy + y^2 dz)$$

from $A:(0,1,2)$ to $B:(1,-1,7)$ by showing that $\mathbf{F}$ has a potential

10. Evaluate the Flux Integral $\iint_S \mathbf{F}\cdot\mathbf{n}\,dA$ for the following data.

$$\mathbf{F} = [3x^2,\ y^2,\ 0],\ \ S:\mathbf{r} = [u,\ v,\ 2u + 3v],\ \ 0 \le u \le 2,\ -1 \le u \le 1$$

11. Prove that

$$hD = \log(1+\Delta) = -\log(1-\nabla) = \sinh^{-1}(\mu\delta).$$

12. Using Taylor series, solve $y' = x - y^2$, $y(0) = 1$. Also find $y(0.1)$ correct to four decimal places.

13. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

Also find $y(2.05)$ and $y(3.18)$ correct to four places of decimal.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $f(x, y, z)$ is a twice differentiable scalar function, then show that div (grad f) = $\Delta^2 f$.

15. Evaluate the surface integral $\iint_S \mathbf{F} \cdot \mathbf{n}\, dA$ by the divergence theorem for the following data:

$\mathbf{F} = [x^2, 0, z^2]$, S the surface of the box given by the inequalities $|x| \le 1, |y| \le 3, |z| \le 2$.

16. Solve $x^3 - 9x + 1 = 0$ for the root between $x = 2$ and $x = 4$, by bisection method.

17. Find the cubic polynomial which takes the following values; $f(1) = 24, f(3) = 120, f(5) = 336,$ and $f(7) = 720$. Hence, or otherwise, obtain the value of $f(8)$.

18. From the following table of values of x and y, obtain $\frac{dy}{dx}$ for $x = 1.2$:

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

19. Use Euler's method with $h = 0.1$ to solve the initial value problem

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 0 \text{ in the range } 0 \le x \le 0.5.$$

Section D

Answer any 2 questions from among the questions 20 to 23.

These questions carry 5 marks each.

20. Prove that curl (curl **F**) = grad div **F** $-\nabla^2$ **F.**

21. Verify Stokes's theorem, for $\mathbf{F} = [y, z, x] = y\mathbf{i} + z\mathbf{j} + x\mathbf{k}$ and S the paraboloid

$$z = f(x, y) = 1 - (x^2 + y^2), \qquad z \geq 0$$

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

FIRST SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

1C01MAT-BCA: Mathematics for BCA –I

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. The derivative of $3\tanh^{-1} x$ is …………..
2. State Maclaurin's Theorem.
3. Find $\lim_{(x,\,y)\to(\sqrt{2},\,\sqrt{2})} \dfrac{x+y+1}{x^2-y^2+1}$.
4. Represent the polar coordinate $(-3,\ 0)$ in polar graph.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. If $x^y y^x = 1$, find $\dfrac{dy}{dx}$.
6. If $x = 5(\cos t + t\sin t),\ \ y = 5(\sin t - t\cos t)$, find $\dfrac{d^2 y}{dx^2}$.
7. Expand $\ln(1+x)$ by Maclaurin's series.
8. Verify Lagrange's mean value theorem for the function

$$f(x) = e^x \quad \text{on } [0,\ 1].$$

9. Discuss the graph of $y = \cosh x$.
10. Find $\lim_{x\to 0} \dfrac{(1+x)^n - 1}{x^2}$.
11. Verify that $\dfrac{\partial^3 u}{\partial y \partial x^2} = \dfrac{\partial^3 u}{\partial x^2 \partial y}$, where $u = 100x^3y^2 + x^2y^3$.
12. If $v = f\left(\frac{x}{z}, \frac{y}{z}\right)$, show that $x\dfrac{\partial v}{\partial x} + y\dfrac{\partial v}{\partial y} + z\dfrac{\partial v}{\partial z} = 0$.
13. If A, B, C are the angles of a triangle such that $\sin^2 A + \sin^2 B + \sin^2 C = K$,

    where K is a constant, prove that $\dfrac{dA}{dB} = \dfrac{\tan B - \tan C}{\tan C - \tan A}$.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. If $y = \cos(m\sin^{-1}x)$ show that $(1-x^2)y_{n-2} - (2n+1)xy_{n-1} + (m^2 - n^2)y_n = 0.$

15. Expand $e^{a\sin^{-1}x}$ in powers of x by Maclaurin's Theorem.

16. Use Cauchy's Mean Value Theorem to evaluate $\lim_{x\to 1} \dfrac{\cos \frac{\pi x}{2}}{\log \frac{1}{x}}$.

17. If $u = \sin^{-1}\left(\dfrac{x^3 - y^3}{x+y}\right)$, show that $x\dfrac{\partial u}{\partial x} + y\dfrac{\partial u}{\partial y} = 2\tan u.$

18. Find the curvature at the point $(x,\ y)$ on the curve $x^3 + y^3 = 3axy.$

19. Show, by changing to Cartesian coordinates, that $r = 8\sin\theta$ is a circle and $r = \dfrac{2}{1-\cos\theta}$ is a parabola.

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Use Taylor's theorem to prove that $$\tan^{-1}(x+h) = \tan^{-1}x + h\sin x \cdot \frac{\sin z}{1} - (h\sin z)^2\frac{\sin 2z}{2} + (h\sin z)^3\frac{\sin 3z}{3},$$
where $z = \cot^{-1}x.$

21. Find $\lim_{x\to 0} \dfrac{e^x - e^{-x} - 2\log(1+x)}{x\sin x}.$

22. Find the evolute of the curve $x = a\cos^3 t,\ \ y = a\sin^3 t.$

23. Translate the equation $\rho = 321\cos\phi$ into Cartesian and cylindrical equations .

SECOND SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

2C02MAT-BCA: Mathematics for BCA - II

Time: Three Hours | Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. If the Cartesian form of the curve is given by $x = f(y)$, then the length of arc AB, with y coordinates of A and B as c and d respectively, is given by ………………….

2. The rank of the matrix $A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}$ is ……..

3. List the eigen values of the matrix $B = \begin{bmatrix} 1 & 0 \\ 3 & 2 \end{bmatrix}$.

4. Fill in the blanks: If both loops and multiple lines are allowed, the resulting graph is called ……………….

Section B

Answer any 7 questions from among the questions 5 to 13. These questions carry 2 marks each.

5. Find the area bounded by the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$.

6. Find the area of the surface generated by revolving the arc of the catenary $y = c\cosh\frac{x}{c}$ from $x = 0$ to $x = c$ about the x-axis.

7. Evaluate $\int_0^1 \int_0^2 \int_0^2 x^2 yz \, dz \, dy \, dx \cdot$

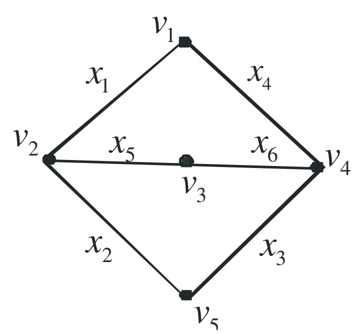
8. Prove that the inverse of an orthogonal matrix is orthogonal.

9. Using Cramer's rule solve $x + y + z = 3,\ x + 2y + 3z = 4,\ x + 4y + 9z = 6.$

10. If $A = \begin{pmatrix} 1 & 3 & 3 \\ 1 & 4 & 3 \\ 1 & 3 & 4 \end{pmatrix}$, find A^{-1}

11. Let G be a bigraph with p points and q lines. Then show that $q \leq \frac{p^2}{4}$.

12. Give the adjacency and incidence matrices of the following graph:



13. Verify that the partition $P = (6,6,5,4,3,3,1)$ is graphical.

Section C

Answer any* 4 *questions from among the questions* 14 *to* 19. *These questions carry* 3 *marks each.

14. Find the whole length of the astroid $x^{2/3} + y^{2/3} = a^{2/3}$.

15. Solve the following system of equations:

$$\begin{aligned} x + y + z &= 9 \\ 2x + 5y + 7z &= 52 \\ 2x + y - z &= 0 \end{aligned}$$

16. Verify Cayley Hamilton theorem for the matrix $A = \begin{bmatrix} 1 & 4 \\ 2 & 3 \end{bmatrix}$.

17. Prove that the eigen values of a triangular matrix are the same as its diagonal elements.

18. Using Cayley-Hamilton theorem find the inverse of

$$A = \begin{bmatrix} 1 & 2 \\ 3 & 4 \end{bmatrix}.$$

19. Prove that the maximum number of lines among all p points graphs with no triangles is $\left[\frac{p^2}{4}\right]$.

Section D

Answer any 2 questions from among the questions 20 to 23. These questions carry 5 marks each.

20. Change the order of integration and hence evaluate the double integral $\int_0^1 \int_x^{2-x} \frac{x}{y} dydx$

21. Investigate for what values of λ and μ the simultaneous equations

$$x + y + z = 6$$
$$x + 2y + 3z = 10$$
$$x + 2y + \lambda z = \mu$$

have

(ix) no solution ;

(x) a unique solution ; and

an infinite number of solutions.

22. Find the eigen values and corresponding eigen vectors of the matrix $A = \begin{bmatrix} 10 & 3 \\ 4 & 6 \end{bmatrix}$.

23. Let G_1 be a (p_1, q_1) graph and G_2 a (p_2, q_2) graph with $V_1 \cap V_2 = \emptyset$. Then prove the following:

(i) $G_1 \cup G_2$ is a $(p_1 + p_2, q_1 + q_2)$ graph.

(ii) $G_1 + G_2$ is a $(p_1 + p_2, q_1 + q_2 + p_1 p_2)$ graph.

(iii) $G_1 \times G_2$ is a $(p_1 p_2, q_1 p_2 + q_2 p_1)$ graph.

THIRD SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

3C03MAT-BCA: Mathematics for BCA -III

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. Examine that $y = e^{5x}$ is a solution of the differential equation $\frac{dy}{dx} = 5y$.
2. The value of $\mathcal{L}[t]$, where $\mathcal{L}$ denotes the Laplace transform operator, is ……………..
3. The primitive period of $\cos\frac{\pi}{2}x$ is …………..
4. Give three dimensional Laplace equation.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Solve the initial value problem $ay' = b - ky;\quad y(0) = 0,$ where a, b, k are constants.
6. Show that the equation

   $\cos x(\cos x - \sin a \sin y)dx + \cos y(\cos y - \sin a \sin x)dy = 0$ is exact and solve it.
7. Solve the linear differential equation $y' - y = e^{2x}$.
8. Solve the initial value problem

   $$y'' - y' - 2y = 0,\quad y(0) = 4,\quad y'(0) = 1.$$
9. Find a general solution of the following differential equation

   $$(D^2 + 2D + 2)y = 0\ ,$$

   where D is the differential operator.
10. Solve $x^2 y'' - 2.5xy' - 2y = 0.$
11. Using Linearity Theorem, obtain the value of $L(\sin at)$.
12. Find the inverse Laplace transform of $\frac{1}{s}\left(\frac{s+1}{s^2+a}\right)$.

13. Show that the functions $u = x^2 - y^2$ and $u = e^x \sin y$ are solutions of the two dimensional Laplace equation.

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. Solve $x\dfrac{dy}{dx} + y = xy^3$.

15. Solve the nonhomogeneous equation

$$y'' - y' - 2y = 10\cos x.$$

16. When n is a positive integer, find a reduction formula for $\mathcal{L}[t^n]$ and hence evaluate $\mathcal{L}[t^n]$.

17. Find the Fourier series of the function

$$f(x) = \begin{cases} x + x^2 & -\pi < x < \pi \\ \pi^2 & \text{when } x = \pm\pi \end{cases}$$

Deduce that $1 + \dfrac{1}{2^2} + \dfrac{1}{3^2} + \ldots = \dfrac{\pi^2}{6}$.

18. Solve the partial differential equation $u_y + 2\,y\,u = 0$, where u is a function of two variables x and y.

19. Using the indicated transformation, solve

$$u_{xy} - u_{yy} = 0 \qquad (v = x, \;\; z = x + y)$$

Section D

***Answer any* 2 *questions from among the questions* 20 *to* 23.**

These questions carry* 5 *marks each.

20. Find the orthogonal trajectory of the family of circles $(x - c)^2 + y^2 = c^2$.

21. By method of variation of parameters, solve the differential equation

$$y'' + y = \sec x.$$

22. Applying Laplace transform, solve the initial value problem $y'' + 4y' + 3y = 0$, given $y(0)=3$, $y'(0) = 1$.

23. Obtain the (i) Fourier sine series and (ii) Fourier cosine series for the function

$$f(x) = x \text{ for } x \in [0, \pi].$$

FOURTH SEMESTER B.Sc. DEGREE EXAMINATION

Mathematics (Complementary)

4C04MAT-BCA: Mathematics for BCA -IV

Time: Three Hours Maximum Marks: 40

Section A

All the first 4 questions are compulsory. They carry 1 mark each.

1. If there are a black balls and b white balls in a box and one ball is drawn at random. Find the probability of black ball coming out.
2. Write three components of a LPP.
3. State Intermediate Value Theorem.
4. Give the Newton-Raphson iteration formula.

Section B

Answer any 7 questions from among the questions 5 to 13.

These questions carry 2 marks each.

5. Prove that the mathematical expectation of a sum of a number of random variables is equal to the sum of their expectations.
6. State and prove Chebyshev's inequality.
7. Define the following:
   (i) Continuous random variable
   (ii) Discrete random variable
   (iii) Independent random variable
8. Write the major steps in the solution of a LPP by graphical method.
9. Define the following:
   (i) Feasible solution
   (ii) Optimum solution.
10. Prove that the set of feasible solutions to an LPP is a convex set.
11. Solve $x^3 - 9x + 1 = 0$ for the root between $x = 2$ and $x = 4$, by bisection method.

12. Prove that

$$hD = \log(1+\Delta) = -\log(1-\nabla) = \sinh^{-1}(\mu\delta).$$

13. For the following table of values, estimate *f*(7.5), using Newton's backward difference interpolation formula.

x	f	∇f	$\nabla^2 f$	$\nabla^3 f$	$\nabla^4 f$
1	1				
2	8	7			
			12		
		19		6	
3	27				0
			18		
		37		6	
4	64		24		0
		61		6	
5	125		30		0
		91		6	
			36		
6	216				0
		127		6	
			42		
7	343				
		169			
8	512				

Section C

***Answer any* 4 *questions from among the questions* 14 *to* 19.**

These questions carry* 3 *marks each.

14. A fair coin is tossed 6 times. Find the expected number of heads.

15. Explain Vogel's approximation method.

16. Find the cubic polynomial which takes the following values; $f(1) = 24, f(3) = 120, f(5) = 336,$ and $f(7) = 720$. Hence obtain the value of $f(8)$.

17. From the following table of values of x and y, obtain $\frac{dy}{dx}$ for $x = 1.2$:

x	1.0	1.2	1.4	1.6	1.8	2.0	2.2
y	2.7183	3.3201	4.0552	4.9530	6.0496	7.3891	9.0250

18. Solve by Picard's method

$$y' - xy = 1, \text{ given } y = 0, \text{ when } x = 2.$$

Also find $y(2.05)$ and $y(3.18)$ correct to four places of decimal.

19. Use Euler's method with $h = 0.1$ to solve the initial value problem

$$\frac{dy}{dx} = x^2 + y^2 \text{ with } y(0) = 0 \text{ in the range } 0 \le x \le 0.5.$$

Section D

Answer any 2 questions from among the questions 20 to 23. These questions carry 5 marks each.

20. Let X be a random variable with distribution:

x	1	2	3
$P(X = x)$	0.3	0.5	0.2

Find the mean, variance, and standard deviation of X. Then find the distribution, mean, variance, and standard deviation of the random variable $Y = \Phi(X)$, where $\Phi(X) = x^2 + 3x + 4$.

21. Obtain an initial basic feasible solution to the following transportation problem using the north-west corner rule.

	D	E	F	G	Available
A	11	13	17	14	250
B	16	18	14	10	300
C	21	24	13	10	400
Requirement	200	225	275	250	

22. Find an approximate value of $\log_e 5$ by calculating $\int_0^5 \frac{dx}{4x+5}$, by Simpson's 1/3 rule of integration.

23. Use Runge-Kutta method with $h = 0.2$ to find the value of y at $x = 0.2$, $x = 0.4$, and $x = 0.6$, given $\frac{dy}{dx} = 1 + y^2$, $y(0) = 0$.

KANNUR UNIVERSITY MODEL QUESTION PAPER
FIRST SEMESTER B Sc DEGREE EXAMINATION
COMPLEMENTARY COURSE
1C01 AST: ASTRONOMY-I

Time: 3 Hours **Max.Marks:40**

Section A
Answer the following 4 questions.Each carry 1 mark.

1. Define spherical triangle.
2. What is comet.
3. What is meant by morning star.
4. Explain terrestrial latitudes.

Section B
Answer any 7 questions. Each carry 2 marks.

5. Prove that the points of intersection of two great circles are the poles of the great circle joining their poles.
6. In a spherical triangle ABC prove that $\frac{sin(A+B)}{sinC} = \frac{cos\ a+cos\ b}{1+cos\ c}$.
7. Write short notes on equinoxes and solstices.
8. Explain equatorial system of co-ordinates used to fix the position of any body in the celestial sphere.
9. Show how the R.A and declination of a star can be calculated.
10. Discuss the phenomenon of perpetual day.
11. State in outline the arguments in favour of the earth's rotation.
12. Write short note landing on moon.
13. Write short notes on a) meteors and b)satellites.

Section C
Answer any 4 questions. Each carry 3 marks.

14. State and prove cosine formula.

15. Trace the changes in the co-ordinates of the sun in the course of a year.

16. Write a note on famous astronomers.

17. What are the different zones into which earth is divided? Give astronomical reasons for it.

18. Describe the pendulum experiment of Foucault. What inference do you draw from this experiment?

19. Find the time taken by a star to rise from a small vertical distance x" below the horizon.

Section D
Answer any 2 questions. Each carry 5 marks.

20. a) Find the relation between the spherical and rectangular coordinates.
b) In a spherical triangle ABC if $A = \frac{\pi}{5}, B = \frac{\pi}{3}, and\ C = \frac{\pi}{2}$ show that $a + b + c = \frac{\pi}{2}$.

21. a) Trace the changes in the azimuth of a star in the course of a day.
b) Find the maximum azimuth.

22. a) Find the duration of perpetual day in a place of latitude $\phi > 90° - \omega$.
b) Find the latitude of the place at which the longest day is twice as long as the shortest day.

23. Write short note on a) Ancient astronomy. b) Modern astronomy.

KANNUR UNIVERSITY MODEL QUESTION PAPER
SECOND SEMESTER B Sc DEGREE EXAMINATION
COMPLEMENTARY COURSE
2C02 AST: ASTRONOMY-II

Time: 3 Hours **Max.Marks:40**

Section A
Answer the following 4 questions.Each carry 1 mark.

1. What is twilight.
2. What is meant by astronomical refraction.
3. Define geocentric parallax.
4. What is planetary aberration.

Section B
Answer any 7 questions. Each carry 2 marks.

5. Find an expression for the Dip of horizon.
6. Find the number of consecutive nights having twilight throughout night.
7. Derive the tangent formula for refraction.
8. If at a certain instant the declination of a star is unaffected by refraction, prove that the star culminates between the pole and the zenith, and the azimuth of the star is a maximum at that instant.
9. Find the horizontal parallax of moon by meridian observation.
10. Show that the geocentric parallax of the sun is $\frac{sinPsinP'}{1-sinPcosz'}$ where P is its horizontal parallax and z' its geocentric zenith distance.
11. Find the effect of parallax on the longitude of a star.
12. Explain the terms parsec and light year. Find the relation between them.

13. Show that the ellipses traced out by a star due to parallax and aberration are similar and similarly situated and their axes are in the ratio $1 : 2\pi d$, where d is the distance of the star in light years.

Section C
Answer any 4 questions. Each carry 3 marks.

14. a) Find the duration of twilight. b) Determine the constant of aberration.
15. a) Find the distance between two mountains whose tops are just visible from each other.
    b) Find the condition that twilight may last throughout night.
16. Find the effect of refraction a) on a small horizontal arc b) on the shape of the disc of the sun.
17. a) Find the relation between horizontal parallax and angular radius of a body.
    b) If the moon's horizontal parallax is $57'$ and her angular diameter be $32'$, find her radius and her distance from the earth.
18. a) Prove that due to stellar parallax the apparent position of a star describes an ellipse around the true position.
    b) The distance of a star S is 4 times as much as the distance of another star S_1. If the parallax of S_1 is $0.005''$ find the parallax of S.
19. Find the effect of aberration on the longitude and latitude of a star.

Section D
Answer any 2 questions. Each carry 5 marks.

20. a) Find the duration of twilight when it is shortest.
    b) Summarise the effects of Dip.
21. a) Derive Cassini's formula for refraction.
    b) Explain how Dip is affected by refraction.
22. a) Find the change in R.A and declination of a body due to geocentric parallax.
    b) Show that due to horizontal parallax P, the moon's angular radius is increased in the ratio $1 : cosP$.

23. a) Find the distance of a star in light years, given that the parallax of the star is $0.15''$, the sun's parallax $9''$, the earth's radius 4000 miles and the velocity of light 186400 miles per second.
b) Show that the maximum and minimum displacements of a star due to aberration are 2κ and $2\kappa sin\beta$ where κ is the constant of aberration and β the star's latitude.

KANNUR UNIVERSITY MODEL QUESTION PAPER
THIRD SEMESTER B Sc DEGREE EXAMINATION
COMPLEMENTARY COURSE
3C03 AST: ASTRONOMY-III

Time: 3 Hours **Max.Marks:40**

Section A

Answer the following 4 questions.Each carry 1 mark.

1. Define mean anomaly.
2. What is meant by dynamical mean sun.
3. Define sidereal month and synodic month.
4. What is meant by precession of equinoxes?

Section B

Answer any 7 questions. Each carry 2 marks.

5. Explain how the longitude of perigee may be calculated.
6. If v_1 and v_2 are the velocities of the earth at perihelion and aphelion, show that $v_1(1-e) = v_2(1+e)$ where e is the eccentricity of the earth's orbit.
7. Calculate the eccentricity of the earth's orbit around the sun.
8. Define morning and evening. Find the relation between them.
9. Define the terms elongation, conjunction, opposition and quadratures as applied to moon.
10. Show how to calculate the length of a lunar mountain.
11. Describe Nutation and explain a) its physical cause, b) its effects.
12. Give the arguments that led George Gamow to the concept of the hot big bang.
13. Briefly explain the large scale structure of the universe.

Section C
Answer any 4 questions. Each carry 3 marks.

14. Define true anomaly, eccentric anomaly. Find the relation between them.

15. Derive a formula for equation of time and show that it vanishes four times in a year.

16. What are astronomical seasons? Calculate their lengths.

17. What is meant by phase of moon? Find a formula for it in terms of moon's elongation.

18. Write short notes on a) Eisten's universe b) Red shift c) Singularity.

19. Find the effect of precession on the R.A. and declination of a star.

Section D
Answer any 2 questions. Each carry 5 marks.

20. State Kepler's laws of planetary motion. Verify the first two laws in the case of the earth.

21. a) Write short notes on Civil year, Julian Calender, Gregorian Calender.
b) Find the sidereal time at Trivandrum at 5p.m. I.S,T. on 1^{st} April 1949, given that the sidereal time of mean midnight at Greenwich on 1^{st} April was 12h. 36m. 5s. and that the longitude of Trivandrum is $76°59'45''$.

22. Write short notes on a) Age of moon b) Lunar libration c) Golden number d) Harvest moon e) Hunters moon

23. Given the celestial longitude λ and latitude β of a star and the obliquity ω of the ecliptic, obtain the three equations of transformation to find the R.A. and declination of the star. Hence find the effect of precession and nutation on the R.A. and declination of the star.

KANNUR UNIVERSITY MODEL QUESTION PAPER
IV SEMESTER B Sc DEGREE EXAMINATION
COMPLEMENTARY COURSE
4C04 AST: ASTRONOMY-IV

Time: 3 Hours **Max.Marks:40**

Section A
Answer the following 4 questions.Each carry 1 mark.

1. Explain how lunar eclipse is caused.
2. Define umbra and penumbra.
3. What are inner planets and outer planets.
4. What is meant by magnitude of a star?

Section B
Answer any 7 questions. Each carry 2 marks.

5. Show how to calculate the latitude of a place by a single meridian observation.
6. Describe a method of fixing the position of the first point of Aries.
7. Find the condition for the occurrence of a lunar eclipse.
8. Find the condition for the occurrence of a total solar eclipse.
9. Explain the law giving the the distances of planets in terms of the distance of earth from sun.
10. Find when an inferior planet is brightest.
11. Describe the surface structure of the sun.
12. Write short notes on a)Sun spots b) Asteroids.
13. Venus is called the earth's twin sister.Why?

Section C
Answer any 4 questions. Each carry 3 marks.

14. Show how the position of the ecliptic can be fixed at any given instant.
15. Explain how the local time of a place may be determined at any instant a) by meridian observation of the sun b) by the method of equal altitudes.
16. Find the maximum and minimum number of eclipses in a year.
17. Find the positions of two planets when they are stationary as seen from each other.
18. Explain apparent magnitude and absolute magnitude. Derive the relation between them.
19. What are the signs of the zodiac? How are they related to the annual motion of the sun?

Section D
Answer any 2 questions.Each carry 5 marks.

20. Discuss Flamsteed's method of fixing the position of the first point of Aries. What are its advantages?
21. Find the time, duration and magnitude of a lunar eclipse.
22. Discuss the direct and retrograde motions of planets.
23. Write short notes on a) Saturn's rings b)Zodiacal light c) Milky way d) Nebulae e) Dwarfs

Sd/-

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