Maharaja's College Ernakulam

A GOVERNMENT AUTONOMOUS COLLEGE

Re-Accredited by NAAC with 'A Grade'
Affiliated to Mahatma Gandhi University
Centre of Excellence under Govt. of Kerala
Identified by UGC as College with Potential for Excellence

POST GRADUATE AND RESEARCH

DEPARTMENT OF MATHEMATICS

Estd. 1875

Under Graduate Curriculum and Syllabus

(Choice Based Credit Semester System)

B. Sc. MATHEMATICS

For 2020 Admission Onwards

MAHARAJA’S COLLEGE, ERNAKULAM

(A Govt. Autonomous College)

CURRICULUM AND SYLLABUS

FOR

UG -MATHEMATICS PROGRAMME

(MCUSCMM08)

UNDER

CHOICE BASED CREDIT SEMESTER SYSTEM (CBCSS-UG)

For 2020 Admission Onwards

P R E F ACE

The present time is experiencing unprecedented progress in the field of Science and technology in which mathematics is playing a vital role; and so the curriculum and syllabi of any academic programme has to be systematically subjected to thorough revision so as to make them more relevant and significant.

Maharaja's college, Ernakulum is a unique institution of higher learning in the state. Its hoary tradition and consistent achievement in various fields of human activity envelop it with a halo of an outstanding temple of knowledge.

The college was elevated to the status of autonomous College by the Government of Kerala and UGC in the year 2014. This is the only government college in Kerala which has been granted autonomy.

The College is also committed to prepare a comprehensive plan of action for Credit and semester system in Graduate programmes. Various workshops with the participation of the teachers from affiliated colleges and invited experts from other Universities were conducted at our institution. The syllabus and curriculum we present here is the follow-up of such workshops.

We gratefully acknowledge the assistance and guidance received from the academic and governing council of our college and all those who have contributed in different ways in this venture.

It is recommended that the content of this syllabus be reviewed and adapted in the light of the consultative process and based on its application in future curriculum revision initiatives. The syllabus and curriculum also be revised periodically.

I hope this restructured syllabus and curriculum would enrich the students.

Dr. Bloomy Joseph

Chairman Board of Studies (UG)

Maharaja’s College, Ernakulam

(A Government Autonomous College)
Affiliated to Mahatma Gandhi University, Kottayam
Under Graduate Programme in Mathematics
2020 Admission Onwards

Board of Studies in Mathematics

Sl. No.	Name of Member	Designation
1	Dr. Bloomy Joseph	Chairman, BoS Mathematics
2	Dr. K P Naveena Chandran	External Member
3	Dr. Vinod Kumar P B	External Member
4	Sri. P. Padmanabhan	External Member [Industry]
5	Dr. Assia N.V.	External Member [Alumni]
6	Dr. Jaya S	Internal Member
7	Smt. Jaya Augustine	Internal Member
8	Smt. Thasneem T.R.	Internal Member
9	Sri. Murali T.K.	Internal Member
10	Smt. Viji C B	Internal Member
11	Dr. Pramod P K	Internal Member
12		University Nominee

MAHARAJA'S COLLEGE, ERNAKULAM
(A GOVERNMENT AUTONOMOUS COLLEGE)
REGULATIONS FOR UNDER GRADUATE PROGRAMMES
UNDER CHOICE BASED CREDIT SYSTEM 2020

1. TITLE

These regulations shall be called "**MAHARAJA'S COLLEGE (AUTONOMOUS) REGULATIONS FOR UNDER GRADUATE PROGRAMMES UNDER CHOICE BASED CREDIT SYSTEM 2020**"

2. SCOPE

Applicable to all regular Under Graduate Programmes conducted by the Maharaja's College with effect from 2020 admissions

Medium of instruction is English except in the case of language courses other than English unless otherwise stated therein.

The provisions herein supersede all the existing regulations for the undergraduate programmes to the extent herein prescribed.

3. DEFINITIONS

'Academic Week' is a unit of five working days in which the distribution of work is organized from day one to day five, with five contact hours of one hour duration on each day.

'Choice Based Course' means a course that enables the students to familiarize the advanced areas of core course.

'College Coordinator' is a teacher nominated by the College Council to co-ordinate the continuous evaluation undertaken by various departments within the college. He/she shall be nominated to the college level monitoring committee.

'Common Course I' means a course that comes under the category of courses for English.

'Common Course II' means additional language.

'Complementary Course' means a course which would enrich the study of core courses.

'Core course' means a course in the subject of specialization within a degree programme. It includes a course on environmental studies and human rights.

'Course' means a portion of a subject to be taught and evaluated in a semester (similar to a paper under annual scheme).

*'**Credit'*** is the numerical value assigned to a paper according to the relative importance of the syllabus of the programme**.**

'Department' means any teaching department in a college.

'Department Coordinator' is a teacher nominated by a Department Council to co- ordinate the continuous evaluation undertaken in that department.

'Department Council' means the body of all teachers of a department in a college.

'Faculty Advisor' means a teacher from the parent department nominated by the Department Council, who will advise the student on academic matters.

Grace Marks shall be awarded to candidates as per the University Orders issued from time to time**.**

'Grade' means a letter symbol (A, B, C, etc.), which indicates the broad level of performance of a student in a Paper/Course/ Semester/Programme.

'Grade Point' (GP) is the numerical indicator of the percentage of marks awarded to a student in a course.

'Parent Department' means the department which offers core course/courses within an undergraduate programme.

'Programme' means a three year programme of study and examinations spread over six semesters, the successful completion of which would lead to the award of a degree.

'Semester' means a term consisting of a minimum **90** working days, inclusive of tutorials, examination days and other academic activities within a period of six months**.**

'Vocational Course' **(Skill Enhancement Course)** means a course that enables the students to enhance their practical skills and ability to pursue a vocation in their subject of specialization.

4. ELIGIBILITY FOR ADMISSION AND RESERVATION OF SEATS

Eligibility for admissions and reservation of seats for various Undergraduate Programmes shall be according to the rules framed by the University/ State Government in this regard, from time to time.

5. DURATION

The duration of U.G. programmes shall be ***6 semesters***.

There shall be two Semesters in an academic year, the "ODD" semester commences in June and on completion, the "EVEN" Semester commences. There shall be two months' vacation during April and May.

No student shall be allowed to complete the programme by attending more than 12 continuous semesters.

6. REGISTRATION

The strength of students for each programme shall be as per the existing orders, as approved by the University.

Those students who possess the required minimum attendance during a semester and could not register for the semester examination are permitted to apply for Notional Registration to the examinations concerned enabling them to get promoted to the next class.

7. SCHEME AND SYLLABUS

The U.G. programmes shall include **(a)** Common Courses I and II, **(b)** Core Course(s), **(c)** Complementary/Vocational Courses, and **(d)** Choice based course**.**

There shall be Two Choice Based course (Elective Course) in the fifth and sixth semesters. In the case of B.Com Programme there shall be an elective stream from third semester onwards.

Credit Transfer and Accumulation system can be adopted in the programme. Transfer of Credit consists of acknowledging, recognizing and accepting credits by an institution for programmes or courses completed at another institution. The Credit Transfer Scheme shall allow students pursuing a programme in one college to continue their education in another college without break.

A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a course. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual courses. If a candidate secures **F Grade** for any one of the courses offered in a Semester/Programme, **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D Grade** or above within the permitted period. The college shall allow credit transfer, subject to the approval of the concerned board of studies and Academic Council.

Students discontinued from previous regulations CBCSS 2016, can pursue their studies under the new regulation "Regulations for Under Graduate Programmes under Choice Based Credit System 2020"after obtaining readmission.

The practical examinations (external/internal) will be conducted only at the end of even semesters for all programmes. Special sanction shall be given for those programmes which need to conduct practical examinations at the end of odd semesters.

8. PROGRAMME STRUCTURE Model I/II BA/B.Sc.

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	22
d	Credits required from Common Course II	16

e	Credits required from Core course and Complementary courses including Project	74
f	Choice Based Core Course	8
g	Minimum attendance required	75%

Model I or Model II B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	14
d	Credits required from Common Course II	8
e	Credits required from Core and Complementary/Vocational courses including Project	90
f	Choice Based Core Course	8
g	Minimum attendance required	75%

Model III BA/B.Sc./B.Com

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	8
d	Credits required from Core + Complementary + Vocational Courses including Project	109
e	Open Course	3
f	Minimum attendance required	75%

BA Honours

a	Programme Duration	6 Semesters
b	Total Credits required for successful completion of the Programme	120
c	Credits required from Common Course I	16
d	Credits required from Common Course II	8
e	Credits required from Core + Complementary + Vocational Courses including Project	93
f	Choice Based Core Course	8
g	Minimum attendance required	75%

9. EXAMINATIONS

The evaluation of each paper shall contain two parts:
Internal or In-Semester Assessment (ISA)
External or End-Semester Assessment (ESA)

The internal to external assessment ratio shall be 1:4.
Both internal and external marks are to be rounded to the next integer.

All papers (theory & practical), grades are given **on a 7-point scale** based on the total percentage of marks, ***(ISA+ESA)*** as given below:-

Percentage of Marks	Grade	Grade Point
95 and above	S Outstanding	10
85 to below 95	A^+ Excellent	9
75 to below 85	A Very Good	8
65 to below 75	B^+ Good	7
55 to below 65	B Above Average	6
45 to below 55	C Satisfactory	5
35 to below 45	D Pass	4

Below 35	F Failure	0
	Ab Absent	0

10. CREDIT POINT AND CREDIT POINT AVERAGE

Credit Point (CP) of a paper is calculated using the formula:- *CP = C × GP, where C is the Credit and GP is the Grade point*

Semester Grade Point Average (SGPA) of a Semester is calculated using the formula:-

SGPA = TCP/TC, where TCP is the Total Credit Point of that semester.

Cumulative Grade Point Average (CGPA) is calculated using the formula:-

CGPA = TCP/TC, where TCP is the Total Credit Point of that programme.

Grade Point Average (GPA) of different category of courses viz. Common Course I, Common Course II, Complementary Course I, Complementary Course II, Vocational course, Core Course is calculated using the formula:-

GPA = TCP/TC, where TCP is the Total Credit Point of a category of course. TC is the total credit of that category of course

Grades for the different courses, semesters and overall programme are given based on the corresponding CPA as shown below:

GPA	**Grade**
9.5 and above	**S Outstanding**
8.5 to below 9.5	**A+ Excellent**
7.5 to below 8.5	**A Very Good**
6.5 to below 7.5	**B+ Good**
5.5 to below 6.5	**B Above Average**
4.5 to below 5.5	**C Satisfactory**
3.5 to below 4.5	**D Pass**
Below 3.5	**F Failure**

11. MARKS DISTRIBUTION FOR EXTERNAL AND INTERNAL EVALUATIONS

The external theory examination of all semesters shall be conducted by the college at the end of each semester. Internal evaluation is to be done by continuous assessment. For all courses without practical total marks of external examination is 80 and total marks of internal evaluation is 20. Marks distribution for external and internal assessments and the components for internal evaluation with their marks are shown below:

For all courses without practical

Marks of external Examination : 80

Marks of internal evaluation : 20

Components of Internal Evaluation of theory	Marks
Attendance	**5**
Assignment /Seminar/Viva	**5**
Test papers (2x5=10)(Marks of test paper shall be average)	**10**
Total	**20**

For all courses with practical total marks for external evaluation is 60 and total marks for internal evaluation is 15.

For all courses with practical

Marks of external Examination : 60

Marks of internal evaluation : 15

Components of Internal Evaluation	Marks
Attendance	**5**
Seminar/Assignments/Viva	**2**
Test paper (2x4)	**8**
Total	**15**

For practical examinations total marks for external evaluation is 40 for internal evaluation is 10

Components of Internal Evaluation (Practicals)	**Marks**
Attendance	**2**
Test (1x4)	**4**
Record*	**4**
Total	**10**

***Marks awarded for Record should be related to number of experiments recorded

Project Evaluation

Components of Project evaluation	**Marks**
Internal Evaluation*	20
Dissertation (end semester)	50
Viva Voce(end Semester)	30

Components of Project Internal evaluation *

Components of internal evaluation	Marks
Relevance and Contents	5
Analysis and Presentation	5
Presubmission Presentation and viva	10

*Marks awarded for Record should be related to number of experiments recorded and duly signed by the teacher concerned in charge.

All three components of internal assessments are mandatory.

For projects

Marks of external evaluation : 80

Marks of internal evaluation : 20

c)

Components of External Evaluation of Project	**Marks**
Dissertation (External)	50
Viva-Voce (External)	30
Total	**80**

*****Marks for dissertation may include study tour report if proposed in the syllabus.

Components of internal Evaluation of Project	**Marks**
Punctuality	5
Experimentation/data collection	5
Knowledge	5
Report	5
Total	**20**

Attendance Evaluation for all papers

% of attendance	**Marks**
90 and above	5
85 – 89	4
80-84	3
76-79	2
75	1

(Decimals are to be rounded to the next higher whole number)

12. ASSIGNMENTS

Assignments are to be done from 1st to 6th Semesters. At least one assignment should be done in each semester for all courses.

13. SEMINAR/VIVA

A student shall present a seminar in the 5th semester for each paper and appear for Viva-voce in the 6th semester for each course.

14. INTERNAL ASSESSMENT TEST PAPERS

Two test papers are to be conducted in each semester for each course. The evaluations of all components are to be published and are to be acknowledged by the candidates. All documents of internal assessments are to be kept in the college for one year and shall be made available for verification. The responsibility of evaluating the internal assessment is vested on the teacher(s), who teach the course.

Grievance Redressal Mechanism

Internal assessment shall not be used as a tool for personal or other type of vengeance. A student has all rights to know, how the teacher arrived at the marks. In order to address the grievance of students, a three-level Grievance Redressal mechanism is envisaged. A student can approach the upper level only if grievance is not addressed at the lower level.

1. Level 1: Department Level:

The Department cell chaired by the HOD, Department Coordinator, Faculty Advisor and Teacher in-charge as members.

2. Level 2: **College level**

A committee with the Principal as Chairman, College Coordinator, HOD of concerned Department and Department Coordinator as members.

The College Council shall nominate a Senior Teacher as coordinator of internal evaluations. This coordinator shall make arrangements for giving awareness of the internal evaluation components to students immediately after commencement of I semester

The internal evaluation marks/grades in the prescribed format should reach the Controller of Examination before the 4th week of October and March in every academic year.

15. EXTERNAL EXAMINATION

The external theory examination of all semesters shall be conducted by the Controller of Examinations at the end of each semester.

Students having a minimum of 75% average attendance for all the courses only can register for the examination. Condonation of shortage of attendance to a maximum of 10 days in a semester subject to a maximum of 2 times during the whole period of the programme may be granted by the subcommittee of the college council on valid grounds. This condonation shall not be counted for internal assessment. Benefit of attendance may be granted to students attending University/College union/Co-curricular activities by treating them as present for the days of absence, on production of participation/attendance certificates, within one week, from competent authorities and endorsed by the Head of the institution. This is limited to a maximum of 10 days per semester and this benefit shall be considered for internal assessment also. Those students who are not eligible even with condonation of shortage of attendance shall repeat the **semester** along with the next batch after obtaining readmission upon the recommendations of the head of the department and college council

All students are to do a **project in the area of core course.** This project can be done individually or in groups (not more than three students). for all subjects which may be carried out in or outside the campus. The projects are to be identified during the V semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department at the sixth semester and are to be produced before the examiners appointed by the College.

There shall be supplementary exams only for fifth semester. Notionally registered candidates can also apply for the said supplementary examinations. For reappearance/ improvement for other semesters the students can appear along with the next batch.

A student who registers his/her name for the external exam for a semester will be eligible for promotion to the next semester.

A student who has completed the entire curriculum requirement, but could not register for the Semester examination can register notionally, for getting eligibility for promotion to the next semester.

A candidate who has not secured minimum marks/credits in internal examinations can re-do the same registering along with the external examination for the same semester, subsequently. **There shall be no improvement for internal evaluation**.

14. All courses shall have unique alphanumeric code.

16. PATTERN OF QUESTIONS

Questions shall be set to assess knowledge acquired, standard and application of knowledge, application of knowledge in new situations, critical evaluation of knowledge and the ability to synthesize knowledge. The question setter shall ensure that questions covering all skills are set. She/he shall also submit a detailed scheme of evaluation along with the question paper. A question paper shall be a judicious mix of short answer type, short essay type /problem solving type and long essay type questions.

3. Pattern of questions Papers

1. Without practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	Short Answer/problem type	2	10/12	20
2	Short essay/problem	5	6/9	30

3	**Essay/problem**	**15**	**2/4**	**30**
			Total	**80**

2. With practical

Sl. No.	Pattern	Marks	Choice of questions	Total marks
1	**Short Answer/problem type**	**1**	**10/12**	**10**
2	**Short essay/problem**	**5**	**6/9**	**30**
3	**Essay/problem**	**10**	**2/4**	**20**
			Total	**60**

Each BOS shall specify the length of the answers in terms of number of words. Pattern of questions for external examination of practical papers will decided by the concerned Board of Studies/Expert Committees.

17. MARK CUM GRADE CARD

The College shall issue to the students a MARK CUM GRADE CARD on completion of the programme.

Note: A separate minimum of 30% marks each for internal and external (for both theory and practical) and aggregate minimum of 35% are required for a pass for a paper. For a pass in a programme, a separate minimum of **Grade D** is required for all the individual papers. If a candidate secures **F Grade** for any one of the paper offered in a Semester/Programme **only F grade** will be awarded for that Semester/Programme until he/she improves this to **D GRADE** or above within the permitted period.

19. There shall **be 2 level monitoring** committees for the successful conduct of the scheme. They are -

1. Department Level Monitoring Committee (DLMC), comprising HOD and two senior- most teachers as members.

2. College Level Monitoring Committee (CLMC), comprising Principal, Secretary Academic Council, College Council secretary and A.A/Superintendent as members.

PROGRAMME OUTCOMES

After successfully completing any three-year under graduate program, a student is expected to achieve the following attributes.

1. **Scientific temper and critical thinking.** Mind-set which enables one to follow a way of life that focuses upon the scientific method of understanding reality and the capability to think rationally and reflectively.
2. **Inclusiveness**. Constant exposure to and interaction with disparate social strata for an inclusive mind-set, ethical sensibility and greater social sensitivity and empathy.
3. **Democratic practice and secular outlook**. As envisioned by the Constitution of India.
4. **Sense of equality, equity and environment**. Ability to differentiate between pure equality, social equity and a heightened awareness of how humans dialectically interact with environment.
5. **Synergetic work culture**. Capacity to work in groups and the attitude to consider larger goals greater than personal ones.
6. **Emancipatory and transformative ideals**. Attainment of cherished ideals of education for the eventual empowerment of humanity.

PROGRAMME SPECIFIC OUTCOMES

On Successful completion of this course, students will

1. get the strong base of different areas of Mathematics and to apply those ideas in other disciplines and also in daily life to a certain extent.
2. develop an analytic mind and assists in better organization of ideas and accurate expression of thoughts.
3. be able to understand the world around them with mathematical models of natural phenomena, of human behaviour and of social systems.
4. be able to think critically.

Programme Structure UG

DEPARTMENT OF MATHEMATICS

UG Programme : B.Sc. Mathematics Model I Total Credits: 120

Curriculum

Semester I

Course Code	Course	Credit	Marks: Internal	Marks: External	Marks: Total	Weekly Contact Hours
	Common Course: English					
ENG1CMR01	Paper I Fundamentals of English	4	20	80	100	5
ENG1CMR02	Paper II Magical Spectrum : Modes of Literature	3	20	80	100	4
	Common Course: Additional Language					
ARB1ADL01	Arabic: Literary Appreciation					
HIN1ACM01	Hindi: Fiction(Novel and short stories)	4	20	80	100	4
MAL1ACM01	Malayalam: Kadha, Novel					
SKT1ACM05	Sanskrit: Poetry, Alankara and Vritta					
MAT1COR01	Foundation of Mathematics	3	20	80	100	4
STA1CMM01	Basic Statistics	3	20	80	100	4
PHY1CMM01	Classical Mechanics	3	20	80	100	4
	TOTAL	**20**			**600**	**25**

Semester II

Course Code	Course	Credit	Marks: Internal	Marks: External	Marks: Total	Weekly Contact Hours
	Common Course: English					
ENG2CMR03	Paper III Contemporary issues and concerns.	4	20	80	100	5
ENG2CMR04	Paper IV Classics : New and Old	3	20	80	100	4
	Common Course: Additional Language					
ARB2ADL02	Arabic: Basic Skills in Translation					
HIN2ACM02	Hindi: Prose, Grammar and Translation.	4	20	80	100	4
MAL2ACM02	Malayalam: Adhunika kavitha					
SKT2ACM10	Sanskrit: Prose and Fables					
MAT2COR02	Analytic Geometry and Matrices	3	20	80	100	4
STA2CMM02	Theory of random variable	3	20	80	100	4
PHY2CMM02	Electricity, Optics and Lasers	3	20	80	100	4
	TOTAL	**20**			**600**	**25**

	ENG3CMR05	Common Course: English Expressions of identity	4	20	80	100	5		ENG4CMR06	Common Course: English Stories to inspire.	4	20	80	100	5
		Common Course: Additional Language								**Common Course**: Additional Language					
	ARB3ADL03	Arabic: Modern Literature							ARB4ADL04	Arabic: Communicative Language					
Semester III	HIN3ACM03	Hindi:Ancient and Modern poetry	4	20	80	100	5	**Semester IV**	HIN4ACM04	Hindi: Drama and one act play.	4	20	80	100	5
	MAL3ACM03	Malayalam: Arangum Porulum.							MAL4ACM04	Malayalam: Gadyam – rachanaparichayam.					
	SKT3ACM03	Sanskrit: Drama and Performing arts of Kerala.							SKT4ACM04	Sanskrit: Historical Survey of Sanskrit literature and kerala culture.					
	MAT3COR03	**Calculus**	4	20	80	100	5		MAT4COR04	Integral Calculus, Theory of Equations and Fourier series	4	20	80	100	5
	STA3CMM03	Probability Distributions	4	20	80	100	5		STA4CMM04	Statistical Inference	4	20	80	100	5
	PHY3CMM03	Properties of Matter and Thermodynamics	4	20	80	100	5		PHY4CMM04	Quantum Mechanics & Nuclear Physics	4	20	80	100	5
		TOTAL	**20**			**500**	**25**			**TOTAL**	**20**			**500**	**25**
	MAT5COR05	Mathematical Analysis	4	20	80	100	5		MAT6COR09	Real Analysis	4	20	80	100	5
	MAT5COR06	Differential Equations	4	20	80	100	6		MAT6COR10	Complex Analysis	4	20	80	100	5
Semester V	MAT5COR07	Abstract Algebra	4	20	80	100	5	**Semester VI**	MAT6COR11	Transforms and special function	4	20	80	100	5
	MAT5COR08	Human Rights& mathematics for environmental studies	4	20	80	100	4		MAT6COR12	Linear Algebra	4	20	80	100	5
	MAT5CBP01	Choice based paper I Numerical Analysis	4	20	80	100	5		MAT5CBP02	Choice based paper I Operations Research	3	20	80	100	4
									MAT6V01	Project and Viva	1	20	80	100	1
		TOTAL	**20**			**500**	**25**			**TOTAL**	**20**			**600**	**25**

COURSE STRUCTURE

Mathematics (Core Course)

Semester	Title of the Course	Number of hours per week	Total Credits	Total hours/ semester	End Semester Exam Duration	Mark	
						ISA	ESA
1	MAT1COR01 - **Foundation of Mathematics**	4	3	72	3	20	80
2	MAT2COR02– **Analytic Geometry and Matrices**	4	3	72	3	20	80
3	MAT3COR03 – **Calculus**	5	4	90	3	20	80
4	MAT4COR04 – **Integral Calculus, Theory of Numbers and Fourier series**	5	4	90	3	20	80
5	MAT5COR05– **Mathematical Analysis**	5	4	90	3	20	80
	MAT5COR06 – **Differential Equations**	6	4	108	3	20	80
	MAT5COR07 – **Abstract Algebra**	5	4	90	3	20	80
	MAT5COR08- **Human Rights and Mathematics for Environmental Studies**	4	4	72	3	20	80
	MAT5CBP01 – Choice based paper I	5	4	90	3	20	80

6	MAT6COR09 – **Real Analysis**	5	4	90	3	20	80
	MAT6COR10 – **Complex Analysis**	5	4	90	3	20	80
	MAT6COR11 – **Transforms and Special Functions**	5	4	90	3	20	80
	MAT6COR12 – **Linear Algebra**	5	4	90	3	20	80
	MAT6CBP02– Choice based paper II	4	3	72	3	20	80
	Project	**1**	1	18	-	20	80

Choice based papers during the fifth Semester

Code	**Title of the Course**	**No. of contact hrs/week**	**No. of Credit**	**Duration of Exam**
MAT5CBP01	**Numerical Analysis**	5	4	3 hrs

Choice based papers during the Sixth Semester

Code	Title of the Course	No. of contact hrs/week	No. of Credit	Duration of Exam
MAT6CBP02	**Operations Research**	4	3	3 hrs

Projects :

All students must do a project. The project can be done individually or as a group of maximum 3 students. However, the viva on this project will be conducted individually. The projects are to be identified during the VIth semester of the programme with the help of the supervising teacher. The report of the project in duplicate is to be submitted to the department and are to be produced before the examiners appointed by the Governing council.

COMPLEMENTARY COURSES:1. Mathematics for B. Sc Physics / Chemistry

Semester	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	End Semester Exam Duration	Mark	
						ISA	ESA
1	**MAT1CMP01– Differential Calculus, Trigonometry and Matrices**	4	3	72	3 hrs	20	80
2	**MAT2CMP02 –Application of integrals, Partial Derivatives and Analytic Geometry**	4	3	72	3hrs	20	80
3	**MAT3CMP03– Vector Calculus and Differential Equations**	5	4	90	3hrs	20	80
4	**MAT4CMP04- Fourier Series , Laplace Transforms, Complex Numbers and Numerical Methods**	5	4	90	3hrs	20	80

2. Mathematics for B.A Economics

Semesters	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	End Semester Exam Duration	Mark	
						ISA	ESA
3	**MAT3CME01**: **Graphing functions, Equations and Linear Algebra**	6	4	108	3 hrs	20	80
4	**MAT4CME02: Calculus, Exponential and Logarithmic Functions**	6	4	108	3 hrs	20	80

3. Mathematics for B.A Economics (Honours)

Semesters	Title of the paper	Number of hours per week	Total Credits	Total hours/ semester	End Semester Exam Duration	Mark	
						ISA	ESA
1	**ECH1COR04 Mathematical Economics I**	6	4	108	3 hrs	20	80
2	**ECH2COR08 Mathematical Economics II**	6	4	108	3 hrs	20	80

For the Board of Studies in Mathematics (U G)

Dr. Bloomy Joseph(Chairperson)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 1)
FIRST SEMESTER
MAT1COR01-FOUNDATION OF MATHEMATICS

4 hours/week **80 marks**

Course outcome/Objective

- Introduce the fundamental ideas of limits ;
- conceive the concept of equations and its roots
- To get an idea of complex numbers, hyperbolic functions and basic Number Theory

Text Books:

1. S. Bernard and J.M Child: Higher Algebra, AITBS Publishers, India,2009
2. J.W. Brown and Ruel. V. Churchill _ Complex variables and applications, 8th edition. McGraw Hill.
3. S. L. Loney: Plane Trigonometry Part II, Chand and Company Ltd

Module 1 **(15 hours)**

Complex numbers: Sums and products. Basic algebraic properties. Further properties. Vectors and moduli. Different representations. Exponential forms. Arguments of products and quotients. Product and powers in exponential form. roots of complex numbers. Regions in the complex plane. (Section 1 to 11 of chapter 1 of text 2)

Module II **(20 hours)**

Theory of Equations I: Statement of fundamental Theorem of algebra. Deduction that every polynomial of degree *n* has *n* and only *n* roots. Relation between roots and coefficients. Transformation of equations (relevant topics of chapter 6 Text 1)

Module III **(20 hours)**

Theory of Equations II: Reciprocal equations. Carden's method, Ferrari's method, Symmetric functions of roots (relevant topics of chapter 6 Text 1)

Module IV **(17 hours)**

Trigonometry: Circular and Hyperbolic functions of complex variables, Separation of functions of complex Variables into real and imaginary parts Factorization of x^n-1, x^n+1, $x^{2n}-2x^na^n\cos n\theta+a^{2n}$.summation of infinite series by C+iS method
(Relevant sections of Text 3 chapter 5,6,8,9)

References:

1. M.R Spiegel – Complex Variables, Schaum's Series
2. H.S.Hall, S.R. Knight: Higher Algebra, Surjit Publications, Delhi

BLUE PRINT
MAT1COR01-FOUNDATION OF MATHEMATICS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	7
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION

MODEL QUESTION PAPER

First Semester

Core Course – Mathematics

MAT1COR01 – FOUNDATION OF MATHEMATICS

(Regular/Improvement/Supplementary)

Time: Three Hours   Maximum: 80 Marks

Part A

(Answer any 10 questions. Each question carries 2 marks)

1. Compute the real and imaginary part of z = $\frac{i-4}{2i-3}$.
2. Find Argz, when z = $\frac{-2}{1+i\sqrt{3}}$.
3. Simplify $\frac{1+2i}{3-4i}$ + $\frac{2-i}{5i}$.
4. What is the absolute value of $(1-i)^6$.
5. If the roots of the equation x^3 + px^2 + qx + r = 0 are in arithmetic progression, show that $2p^3$ – 9pq + 27r = 0
6. If α, β, γ are the roots of $2x^3$ + 3 x^2 - x - 1 = 0, find the equation whose roots are α -1 , β-1 , γ -1.
7. If α, β, γ are the roots of x^3 - px^2 + qx – r = 0. Find the value of $\sum \alpha^2$.
8. What is a reciprocal equation? Give an example.
9. Explain Ferrari's Method.
10. Show that $cosh^2x$ - $sinh^2x$ = 1.
11. Show that cosh(x+y) = coshxcoshy + sinhxsinhy.
12. If x = cosθ + isinθ, find x^4 + $\frac{1}{X^4}$ and x^4 - $\frac{1}{X^4}$.

(10 x 2 =20)

Part B

(Answer any 6 questions. Each question carries 5 marks)

13. Find the cube roots of the complex number -8i.
14. State and prove triangle inequality for complex numbers.
15. If α, β, γ are the roots of the equation x^3 - p x^2 + qx - r = 0 . Find the value of $\frac{1}{\alpha^2}$ + $\frac{1}{\beta^2}$ + $\frac{1}{\gamma^2}$
16. Prove that every polynomial equation of degree n≥1 has exactly n roots.
17. Solve the equation x^3 – 12x - 65 = 0 by cardan's method.
18. Solve $6x^5$ + 11 x^4 - 33x^2 + 11x + 6 = 0.
19. Separate into real and imaginary parts of tan(x+iy).
20. Expand $\sin^6\theta$ in a series of cosines of multiples of θ.
21. Sum the series $\frac{1}{2}$ sinα + $\frac{1.3}{2.4}$ sin2α + $\frac{1.3.5}{2.4.6}$ sin3α+…….

(6 x 5 = 30)

Part C

(Answer any 2 questions. Each question carries 15 marks)

22. (a). Prove that z is real if and only if $\bar{z}$ = z.

(b). Prove that z is either real or purely imaginary if and only if $\bar{z}^2 = z^2$.

23. (a). Solve $24x^3$ - 14 x^2 - 63 x + 45 = 0 having given that one root being double another.

(b). α, β, ϒ are the roots of x^3 + px + q = 0. Prove that $\frac{1}{5}\sum\alpha^5 = \sum\alpha^3\sum\alpha^2$

24. (a). Solve the reciprocal equation $60x^4$ - 736 x^3 + 1433x^2 - 736x + 60 = 0.

(b). Solve x^3 - 9x + 28 = 0 by Cardan's method.

25.(a). Separate into real and imaginary parts the quantity $\sin^{-1}(\cos\theta + i\sin\theta)$ where θ is real.

(b). Find the sum to infinity the series:

$$c\sin\alpha + \frac{c^2}{2!}\sin 2\alpha + \frac{c^3}{3!}\sin 3\alpha + \dots$$

(15 x 2 = 30)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 2)
SECOND SEMESTER
MAT2COR02-ANALYTIC GEOMETRY AND MATRICES

4 hours/week **80marks**

Course outcome/objective

- Understand more ideas of conics;
- Get an idea of rank of matrices , Characteristic roots and characteristic vectors

Text books:

1. Thomas calculus- Maurice D weir, Joel Hass, Frank R Giordano (Eleventh Edition)
2. Frank Ayres Jr - Matrices, Schaum's Outline Series, TMH Edition.

Module I
Conic Sections **(22 hours)**

Conic sections and quadratic equations, classifying conic sections by eccentricity, quadratic equations and rotations, conic and parametric equations; the cycloid
(Relevant sections 10.1, 10.2 ,10.3, 10.4 of Text 1)

Module II **(20 hours)**
Polar coordinates
Polar coordinates, graphing in polar coordinates.
(Relevant sections 10.5, 10.6 of Text 1)

Module III **(10 hours)**
Polar Equations

Polar co-ordinates, polar equation of a line, polar equation of a circle and polar equation of a conic. Polar equations of tangent and normal to these curves.
(Relevant sections 10.8 of Text 1)

Module IV **(20 hours)**

Matrices: Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary matrices only. Systems of Linear equations: System of nonhomogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem and simple applications. (Text 3, Chapters – 5, 10, 19, 23).

Reference Books:

1. S.K. Stein – Calculus and analytic Geometry , (McGraw Hill)
2. A. N. Das – Analytic Geometry of Two & Three Dimension(New Central Books)

3. Thomas and Finney - Calculus and analytical geometry (Addison-Wesley)

BLUE PRINT
MAT2COR02-ANALYTIC GEOMETRY AND MATRICES

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	2	1	1	4
III	2	2	1	5
IV	4	4	1	9
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE (AUTONOMOUS), ERNAKULAM
MODEL QUESTION PAPER
B.SC DEGREE (CBCSS) EXAMINATION, SECOND SEMESTER
MAT2COR02- ANALYTIC GEOMETRY AND MATRICES

Time: Three hours Maximum:80 Marks

Part A
(Answer any 10 questions. Each carries 2 marks)

1. Prove that in a parabola if the normal at P meets the axis in G, then SG=GP, where S is the focus of the parabola.
2. What is the parametric representation of a point on the parabola $y^2 = -16x$?
3. Find the Cartesian equation corresponding to $r\cos\left(\theta - \frac{\pi}{6}\right) = 4$
4. Prove that the sum of the squares of two conjugate semi diameters of an ellipse is constant.
5. Sketch the curve corresponding to $r = 2\cos\theta$
6. Find the equation of the normal to the rectangular hyperbola $xy=c^2$ at the point 't' using the equation of the normal at 't'.
7. Graph the cardioid $r = 1 - \cos\theta$
8. Find the polar equation corresponding to $\sqrt{2}\,x + \sqrt{2}y = 6$
9. Find the directrix of the parabola $r = \frac{25}{10+10\cos\theta}$
10. What is the relation between rank of A and number of unknowns n if the system of homogeneous equations AX = 0 has an infinite number of solutions?
11. Write the normal form of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 0 & 0 \\ 1 & 1 & 0 \end{bmatrix}$.
12. State Cayley-Hamilton theorem.

Part B
(Answer any 6 questions. Each carries 5 marks.)

13. Prove that the eccentric angles of the ends of a pair of conjugate diameters of an ellipse differ by a right angle.
14. Show that the normal to the rectangular hyperbola $xy= c^2$ at the point P(ct, c/t) meets the curve again at the point $Q(-c/t^3,-ct^3)$.
15. Which curve is represented by the polar equation $r^2\cos\theta\sin\theta = 4$
16. Find the Cartesian equation corresponding to $r = \frac{4}{2\cos\theta - \sin\theta}$
17. Sketch the region defined by the inequalities $-3\cos\theta \leq r \leq 0$
18. Sketch the curve corresponding to $r = 2(1 - \cos\theta)$

19. Find the eigen values of the matrix $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 5 \\ 1 & 2 & 0 \end{bmatrix}$.

20. Find all non-trivial solutions of $x_1+2x_2+3x_3=0$

$$2x_1+x_2+3x_3=0$$
$$3x_1+2x_2+x_3=0.$$

21. Using Cayley-Hamilton theorem, find A^3 for the matrix A= $\begin{bmatrix} 1 & 2 & 3 \\ 0 & 1 & 5 \\ 1 & 2 & 0 \end{bmatrix}$.

Part C

(Answer 2 questions. One from each bunch. Each carries 15marks)

22. If the normal at $(at_1^2, 2at_1)$ to the parabola $y^2=4ax$ meets the curve again at $(at_2^2, 2at_2)$, show that $t_2=-t_1-(2/t_1)$.

OR

23. (i) Graph the curve $r^2 = 4cos\theta$

(ii) Identify the symmetries of the curve $r = 1 + cos\theta$

24. (i) Find the polar equation of the hyperbola with eccentricity $\frac{3}{2}$ and directrix $x = 2$.

(ii) Sketch the region defined by the inequalities $0 \leq r \leq 2cos\theta$

OR

25. Reduce the matrix A=$\begin{bmatrix} 0 & 2 & 3 & 4 \\ 2 & 3 & 5 & 4 \\ 4 & 8 & 13 & 12 \end{bmatrix}$ to normal form.

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 3)
THIRD SEMESTER
MAT3COR03-CALCULUS

5 hours/week **80marks**

Outcome/Objective

- expand a function using Taylor's and Maclaurin's series.
- understand partial derivatives and its applications
- understand vector valued functions.
- calculate the area under a given curve, length of an arc of a curve when the equations are given in parametric and polar form.
- estimate the surface area and volume of solids.

Text Books:

1. George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.

PRE REQUISITE: Successive Differentiation

Module I **(15 hours.)**
Higher Order Derivatives
Rates of change and limits, calculating limits using the limit laws, Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test (Theorems only). Concavity and curve sketching, Taylor and Maclaurin series.

(Sections 2.1,2,2,4.1-4.4 and 11.8 of Text 1)

Module II **(25 hours.)**
Partial Differentiation: Partial derivatives, The chain rule, Extreme values and saddle points, Lagrange multipliers, Partial derivatives with constrained variables. (Section 14.3, 14.4, 14.7, 14.8, 14.9 of Text 1)

Module III **(25 hours.)**
Vector Valued Functions
(A quick review) Lines and planes in space, Vector functions Arc length and Unit tangent vector, Curvature and Unit normal vector, torsion and Unit Binomial vector, Directional derivatives and gradient vectors, tangent planes and Differentials (Sections 12.5, 13.1, 13.3, 13.4, 13.5, 14.5, 14.6 of Text 1)

Module IV **(25 hours.)**
Integral Calculus: Substitution and area between curves, volumes by Slicing and rotation about an axis. Volumes by cylindrical shells, Lengths of Plane Curves, Areas of surfaces of Revolution and the theorems of Pappus.
(Section 5.6, 6.1, 6.2, 6.3, 6.5 of Text 1)

Reference:

1. T. M. Apostol – Calculus Volume I & II (Wiley India)
2. Anton: Calculus, Wiley.

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MAT3COR03-CALCULUS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	2	2	1	5
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE, ERNAKULAM
B.Sc. DEGREE (C.B.C.S.) EXAMINATION, MODEL QUESTION PAPER
Third Semester
Programme – B.Sc. Mathematics
MAT3COR03 - CALCULUS

Time: Three Hours Maximum: 80 Marks

Part A

*(Answer any **ten** questions. Each question carries **2** marks)*

1. Find where the graph of $f(x) = x^4 - 4x^3 + 10$ is concave up and concave down.
2. Write the Maclaurin's series expansion of $sinx$.
3. Find $\lim_{x\to 1} \frac{x^2+x-2}{x^2-x}$
4. State Sandwich theorem
5. Find the local extreme values of $f(x, y) = xy$.
6. Using the chain rule to find the derivative of $w = xy$ with respect to the path $x = cost, y = sint$.
7. Find the unit normal of the curve curve $\overrightarrow{r(t)} =$ $(\cos\ 2\,t)\vec{\imath} + (\sin 2t)\vec{\jmath}$.
8. Find an equation for the tangent to the ellipse $\frac{x^2}{4} + y^2 = 2$ at the point $(-2,1)$.
9. Evaluate $\int_0^{\pi} (\cos t\,\vec{\imath} + \vec{\jmath} - 2t\vec{k})dt$.
10. Find the volume of the solid generated by revolving the region bounded by $y = \sqrt{x}$ and the lines $y = 1,\ x = 4$ about the line $y = 1$.
11. Find the circumference of a circle of radius r defined by $x = r\,cost, y = rsint, 0 \le t \le 2\pi$.
12. State Pappus theorem for volumes.

(10x2=20)

Part B

*(Answer any **six** questions. Each question carries **5** marks)*

13. Expand $logx$ in powers of $(x - 1)$ and hence evaluate $\log 1.1$ correct to 4 decimal places.
14. State and prove The Mean Value Theorem.
15. Find the local extreme values of the function $f(x, y) = xy - x^2 - y^2 - 2x - 2y + 4$.
16. If $z = \log\sqrt{x^2 + y^2}$ then prove that $\frac{\partial^2 z}{\partial x^2} + \frac{\partial^2 z}{\partial y^2} = 0$.
17. Find the curvature for $\overrightarrow{r(t)} = (a\ cost\ )\vec{\imath} + (a\ sint)\vec{\jmath} + bt\,\vec{k}\ , a, b \ge 0, a^2 + b^2 \ge 0$.

18. Find the derivative of $f(x, y) = xe^y + \cos xy$ at the point (2,0) in the direction of $3\vec{\iota} - 4\vec{\jmath}$.

19. Use the shell method to find the volume of the solid obtained by rotating about the y axis and
the regions between $y = x \; and \; y = x^2$.

20. Find the length of the curve $x = t^2, y = t^3$ between (1,1) and (4,8).

21. Find the area of the surface generated by revolving the curve $y = 2\sqrt{x}, 1 \leq x \leq 2$ about the x- axis .

(6x5=30)

Part C

*(Answer any **two**, selecting **one** question from each bunch.*
*Each question carries **15** marks)*

22. The plane $x + y + z = 1$ cuts the cylinder $x^2 + y^2 = 1$ in an ellipse. Find the points on the ellipse that lie closest to and farthest from the origin.

OR

23. Find the area of the surface generated by revolving the curve $y = \frac{x^3}{3}$ around the x axis for $1 \leq x \leq 2$.

24. Find the osculating circle of the parabola $y = x^2$ at the origin.

OR

25. Find the length of the astroid $x = cos^3 t, y = sin^3 t, 0 \leq t \leq 2\pi$.

(2x15=30)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 4)

FOURTH SEMESTER

MAT4COR04-INTEGRAL CALCULUS, THEORY OF NUMBERS AND FOURIER SERIES

5 hours/week **80marks**

Course outcome/Objective

- apply Vector integration in physical problems
- explain the fundamental ideas of limits
- conceive the concept of equation and its roots.

Text Books:

1.George B. Thomas Jr. (Eleventh Edition) – Thomas' Calculus, Pearson, 2008.

2. Erwin Kresyzig – Advanced Engineering Mathematics, VIIIth edition

3. David M Burton - Elementary Number Theory, 7^{th}Edition, McGraw Education (India) Private Ltd.

Module I **(20 hours)**

Multiple Integrals: Double integrals, areas, Double integrals in polar form, Triple integrals in rectangular coordinates, triple integrals in cylindrical and spherical coordinates, substitutions in multiple integrals.

(Section 15.1, 15.2(area only), 15.3, 15.4, 15.6,15.7 of Text 1)

Module II **(30 hours)**

Integration in Vector Fields: Line integrals, Vector fields, work circulation and flux, Path independence, potential functions and conservative fields, Green's theorem in the plane, Surface area and surface integrals, Parameterized surfaces, Stokes' theorem (statement only), Divergence theorem and unified theory (no proof).

(Sections 16.1 to 16.8 of Text 1)

Module III **(20 hours)**

Theory of Numbers: Basic properties of congruence, Fermat's theorem, Wilson's theorem, Euler's phi function.

(Text 3: Chapter 4: section 4.2, Chapter 5: sections 5.2, 5.3 and Chapter 7: section 7.2).

Module IV **(20 hours)**

Fourier series: Periodic functions, Trigonometric series, Functions of any period P=2L, Fourier series, even and odd functions, Half range expansions. (Relevant topics of text 1)

References:

1. H.F. Davis and A.D. Snider: Introduction to Vector Analysis, 6^{th} ed., Universal Book Stall, New Delhi.
2. George E. Andrews: Number Theory, HPC.

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MAT4COR04-INTEGRAL CALCULUS, THEORY OF NUMBERS AND FOURIER SERIES

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. Degree (C.B.C.S.S.) Examination, Model Question Paper
FOURTH SEMESTER
Core Course – Mathematics
MAT4COR04-Intgral Calculus, Theory of Numbers and Fourier Series

Time : Three Hours Maximum : 80 Marks

PART A

(Answer any **ten** questions. Each question carries 2 marks.)

1. Calculate $\iint_R \frac{\sin x}{x}\,dA$ where R is the triangle in the *xy*-plane bounded by the *x* axis, the line $y = x$ and line $x = 1$.
2. Find the spherical coordinate equation for the sphere $x^2+y^2+(z-1)^2 = 1$.
3. Integrate $f(x, y, z) = x-3y^2 + z$ over the line segment C joining the origin to the point (1,1,1).
4. Evaluate $\int_C F, dr$ where $F(x, y, z) = zi + xyj - y^2 k$ along the curve C given by $r(t) = t^2 i + tj + \sqrt{t}k,\ 0 \le t \le 1$.
5. Find the gradient field of the function $g(x, y, z) = xy+yz+xz$.
6. Find the work done by the conservative field $F = yzi + xzj + xyk = \nabla f$ where $f(x, y, z) = xyz$ along any smooth curve C joint the point (- 1, 3, 9) to (1, 6, –4).
7. Find the number of integers less than 1024 and prime to it.
8. Prove that the square of every odd number is of the form 8n+1.
9. State Fermat's Theorem.
10. Sketch the graph of $f(x) = \{^{0;\,-\pi\ <x<0}_{x;\,0\,<\,x\,<\,\pi}$ and has period 2π in the interval $-3\pi < x < 3\pi$
11. Find the smallest positive period of $\cos \pi x$.
12. Write the Fourier cosine series of period *2L*.

(10x2=20)

PART B

(Answer any **six** questions. Each question carries 5 marks.)

13. Evaluate ${}_0\int^7\ {}_0\int^2\ {}_0\int^{\sqrt{4-q^2}}\ dp\,dq\,dr$
14. Solve the system $u = x-y$, $v = 2x+y$ for *x* and *y* in terms of *u* and *v*. Find the value of the Jacobian $\frac{\partial(x,y)}{\partial(u,v)}$
15. Show the $F = (e^x\cos y + yz)i+ (xz-e^x \sin y)j+(xy+z)k$ is conservative over its natural domain and find a potential function for it.
16. Find a parameterization of the cylinder $x^2 + (y-3)^2=9,\ 0\le z \le 5$.
17. If 'n' is any number and 'a' is prime to n, then show that $a^{\varphi(n)} = 1 \pmod n$.
18. Prove that any three consecutive integers is divisible by 3!
19. Find the Fourier series of *f* given by $f(x) = x\sin x$, $0 < x < 2\pi$ and $f(x) = f(x + 2\pi)$
20. Find the Fourier series of *f* given by $f(x) = x^3$, $-\pi< x < \pi$
21. Find the Fourier series of *f* given by $f(x) = \{^{a;\,0\ <x<\pi}_{-a;\,\pi\ <\,x\,<\,2\pi}$ and $f(x) = f(x+2\pi)$

(6x5=30)

PART C

(Answer any two questions. Each question carries 15 marks.)

22. Use Stokes theorem to evaluate $\int_C F \cdot dr$ where $F(x, y, z) = xzi + xyj + 3xzk$ and C is the boundary of the portion of the plane $2x+y+z=2$ in the first octant traversed counter clock wise direction.
23. a) Find the area of the region common to the interiors of the cardioids $r = 1 + \cos\theta$ and $r = 1 - \cos\theta$

    b) Evaluate $\int_0^{\pi} \int_0^{\pi} \int_0^{\pi} \cos(u+v+w)\, du\, dv\, dw$.
24. a) State and prove fundamental theorem of arithmetic

    b) State and prove Wilson's Theorem
25. Find the Fourier series for $f(x) = |x|$ in $[-\pi,\pi]$ with $f(x) = f(x+2\pi)$ for all x. Deduce that $1+\frac{1}{3^2}+\frac{1}{5^2}+\ldots=\frac{\pi^2}{8}$

(2x15=30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 5)
FIFTH SEMESTER
MAT5COR 05-MATHEMATICAL ANALYSIS

5 hours/week **80 marks**

Outcome/Objective

- Understand and use Archimedean property and Completeness property of R.
- Apply the concept of limit of sequences and convergence of infinite Series.
- Understand and apply the concept of limits of functions

Text Book: Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, In. 2007

MODULE I: REAL NUMBERS **(30 hours)**
Finite and Infinite Sets, The Algebraic and Order Properties of R, Absolute Value and Real Line, The Completeness Property of R, Applications of the Supremum Property, Intervals.
(Chapter 1: Section 1.3 and Chapter 2: Sections 2.1, 2.2,2.3,2.4,2.5)

MODULE II: SEQUENCES **(30 hours)**
Sequences and their Limits, Limit Theorems, Monotone Sequences, Sub sequences and the Bolzano- Weierstrass Theorem, The Cauchy Criterion.
(Chapter 3: Sections 3.1,3.2,3.3,3.4, 3.5)

MODULE III: INFINITE SERIES **(20 hours)**
Introduction to Series, Absolute Convergence, Tests for Absolute convergence, Tests for Non absolute Convergence
(Chapter 3: Section 3.7, Chapter 9 : Sections 9.1,9.2,9.3)

MODULE IV: LIMITS **(10 hours)**
Limit of Functions.
(Chapter 4: Section 4.1 only.)

References:
1. Richard R Goldberg - Methods of real Analysis, 3rd edition, Oxford and IBM Publishing Company (1964)
2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)
3. Elias Zako - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)
4. J.M Howie - Real Analysis, Springer 2007.
5. K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.
6. S.C Malik, Savitha Arora - Mathematical Analysis, Revised Second Edition

BLUE PRINT
MAT5COR 05-MATHEMATICAL ANALYSIS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	4	4	2	10
III	3	2	1	6
IV	1	1	0	2
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE (AUTONOMOUS)
MODEL QUESTION PAPER
B.SC DEGREE (CBCSS) EXAMINATION MATHEMATICS CORE
FIFTH SEMESTER
MAT5COR05–MATHEMATICAL ANALYSIS

Time: 3 Hour **Maximum: 80 Marks**

PART A

(Answer any 10 questions. Each carries 2 marks)

1. Write the order properties of $\mathbb{R}$.
2. State the infimum and supremum properties of $\mathbb{R}$
3. Define a countable set.
4. Define $\varepsilon -$ neighbourhood of a real number 'a'.
5. State and Prove Archimedean Property of $\mathbb{R}$
6. Define a Cauchy sequence.
7. Define a monotone sequence.
8. Give two divergent sequence whose sum is a convergent sequence
9. Give an example of a conditionally convergence series.
10. State root test.
11. State squeeze theorem
12. Define limit of a function.

Part-B

(Answer any 6 questions. Each question carries 5marks)

13. If a, b are in $\mathbb{R}$,and a<b, then show that $a<\frac{1}{2}(a+b) < b$
14. State and prove Density Theorem.
15. Show that a convergent sequence of real numbers is bounded.
16. If $\lim_{n\to\infty} x_n$, Show that $\lim_{n\to\infty} |x_n| = |x|$.
17. Show that every absolutely convergent series in R is convergent.
18. If $I_n = [a_n , b_n]$, n$\in N$ is a nested sequence of closed and bounded interval then show that $\exists$ a number c ϵ R such that c ϵ I_n for all n.
19. If $x\neq 2k\pi$, prove that $\sum_{n=1}^{\infty}$ Cosnx a_n converges
20. If (z_n) be a decreasing sequence of strictly positive number, with Lt $z_n=0$, then show that the alternating series $\sum(-1)^{n+1} z_n$ is convergent.
21. State and prove the sequential criterion for limit of a function.

Part C

(Answer any 2questions. Each question carries 15 marks)

22. State and prove Bolzano-Weierstrass theorem.

OR

23. Prove that there exist a positive real number x such that $x^2 =2$.
24. State and Prove Cauchy Criterion for convergence of a sequence.

OR

25. Show that the P-series $\sum \frac{1}{n^p}$ is convergent iff P>1

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 6)

FIFTH SEMESTER

MAT5COR06-DIFFERENTIAL EQUATIONS

6 hours/week **80 marks**

Outcome/Objective

- Analyse types of Differential equation
- Able to solve Differential equation using different methods

Text Books:

1. Shepley L. Ross - Differential Equations, 3^{rd} ed., (Wiley India).
2. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)

Module I **(30 hours)**

Exact differential equations and integrating factors (Proof of theorem 2.1 excluded), separable equations and equations reducible to this form, linear equations and Bernoulli equations, special integrating factors and transformations. (Sections 2.1, 2.2, 2.3, 2.4 of Text 1)

Module II **(23hours.)**

Orthogonal and oblique trajectories., Basic theory of linear differential equations. The homogeneous linear equation with constant coefficients. The method of undetermined coefficients (Sections 3.1, 4.1, 4.2, 4.3, of Text 1)

Module III **(25 hours.)**

Variation of parameters, The Cauchy – Euler equation. Power series solution about an ordinary point s (Sections 4.4, 4.5 6.1 of Text 1)

Method IV **(30 hours)**

Surfaces and Curves in three dimensions, solution of equation of the form

$\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$. Origin of first order and second order partial differential equations, Linear equations of the first order, Lagrange’s method

(Chapter 1, section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text 2)

Reference:

1. A. H. Siddiqi & P. Manchanda – A First Course in Differential Equation with Applications (Macmillian)
2. George. F. Simmons – Differential equation with applications and historical notes (Tata Mc Graw Hill Books Agency)
3. Sankara Rao - Introduction to Partial Differential Equation,2nd edition, PHI.
4. Zafar Ahsan - Differential Equations and their Applications , 2nd edition, PHI

BLUE PRINT
MAT5COR06-DIFFERENTIAL EQUATIONS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE, ERNAKULAM
B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, MODEL QUESTION PAPER
Fifth Semester

Core Course - Mathematics

MAT5COR06 - DIFFERENTIAL EQUATIONS

Time: Three Hours Maximum: 80 Marks

Part A

*(Answer any **ten** questions. Each question carries **2** marks)*

1. Find the general solution of the differential equation $\frac{dy}{dx} = (\cos^2 x)(\cos^2 y)$
2. Find an integrating factor for the equation $ydx - xdy + (x^2 + y^2)dx = 0$ and solve it.
3. Find the wronskain of the functions $e^t \sin t,\ e^t \cos t$.
4. Locate and classify the ordinary and singular points of the differential equation $x^3(x+5)\frac{d^2y}{dx^2} + (x-3)\frac{dy}{dx} - (x-2)y = 0$
5. Find a family of oblique trajectories that intersect the family of circles $x^2 + y^2 = c^2$ at an angle $\alpha = 45^0$.
6. Show that $y_1(t) = e^t$ and $y_2(t) = te^t$ form a fundamental set of solutions of $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0.$
7. Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 0.$
8. Solve the system of simultaneous equations $\frac{dx}{dt} = 7x - y, \frac{dy}{dt} = 2x + 5y.$
9. Form the partial differential equation from $2z = \frac{x^2}{a^2} + \frac{x^2}{b^2}$ by eliminating arbitrary constants.
10. Examine whether the differential equation $(ye^x \sin y)dx + (ye^x \cos y + 1)dy = 0$ is exact or not? Justify your answer.
11. Find the orthogonal trajectory of family of parabolas $y = ax^2$
12. Find the integral curves of the equation $\frac{dx}{y^2 z} = \frac{dy}{x^2 z} = \frac{dz}{y^2 x}.$

(10x2=20)

Part B

*(Answer any **six** questions. Each question carries **5** marks)*

13. Find the orthogonal trajectories of family of circles which are tangent to Y-axis at the origin.
14. Solve the differential equation $(3xy^2 - y^3)dx - (2x^2y - xy^2)dy = 0$
15. Using the method of reduction of order solve the differential equation

    $x^2 \frac{d^2y}{dx^2} - 4x\frac{dy}{dx} + 6y = 0$, given that $y_1 = x^2$ is a solution.
16. Solve the differential equation $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} = e^x \sin(x)$
17. Solve the differential equation $\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 + 2)y = 0$
18. Find the power series solution of the differential equation $\frac{d^2y}{dx^2} + x^2y = 0$.
19. Find the integral curves of the equations $\frac{dx}{(mz - ny)} = \frac{dy}{(nx - lz)} = \frac{dz}{(ly - mx)}$
20. Find the general integral of the linear partial differential equation

    $x^2(y - z)p + y^2(z - x)q = z^2(x - y)$.
21. Solve $y^2p - xyq = x(z-2y)$

(6x5= 30)

Part C

*(Answer any **two** questions selecting **one** question from each bunch.*
*Each question carries **15** marks)*

22. Solve the initial value problem $4\frac{dy}{dx} - y\tan x + y^5 \sin 2x = 0$, given that $y(0) = 1$

OR

23. Solve $\frac{dx}{y^3x - 2x^4} = \frac{dy}{2y^4 - x^3y} = \frac{dz}{2z(x^3 - y^3)}$
24. Solve by the method of variation of parameters the differential equation

    $\frac{d^2y}{dx^2} + 4y = 4\sec^2 x$.

OR

25. Find a power series solution in powers of x of the initial value problem $(x^2 - 1)\frac{d^2y}{dx^2} + 3x\frac{dy}{dx} + xy = 0$ y(0) = 4, y'(0) = 6

(2x15=30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 7)
FIFTH SEMESTER
MAT5COR07-ABSTRACT ALGEBRA

5 hours/week **80 marks**

Outcome/Objective

- understand the concepts of groups.
- explains the concept cyclic group and isomorphism.
- explains the concept homomorphism and integral domain.

Text book:

John B.Fraleigh - A first course in Abstract Algebra (3rd Edition),

Module 1 **(25 hours)**

Group

Binary operation-Groups, Definition and elementary properties-finite groups and group tables-subsets and sub groups-cyclic sub groups-functions and permutations- groups of permutations-examples. Cycles and Cyclic notations-even and odd permutations-the alternating groups. (Chapters 1-5)

Module 2 **(25 hours)**

Cyclic Groups-Elementary Properties-Classification of cyclic groups-Subgroups of finite cyclic groups-Isomorphisms-Definition and elementary properties-How to show that two groups are isomorphic(Not Isomorphic)-Cayle's Theorem-Groups of Cosets -Applications-Criteria for the existence of a coset group-inner automorphisms and normal subgroups-Factor groups-Simple groups(Chapter- 6,7,11,12)

Module 3 **(20 hours)**

Homomorphism-Definition and Elementary Properties-The Fundamental Homomorphism theorem -Applications. Rings, Definition and Basic Properties-Multiplicative questions; Fields-Integral Domains-Divisors of Zero and Cancellation-Integral Domains.
(Chapters- 13,23,24.1,24.2)

Module 4 **(20 hours)**

Ring and Fields

Characteristic of a Ring- Quotient Ring and Ideals-Criteria for The Existence of a Coset Ring-Ideals and Quotient Rings. (Chapters-24.3,28)

References:

1. I.N Herstein - Topics in Algebra
2. Joseph A Gallian - A Contemporary Abstract Algebra, Narosa Pub. House.
3. P.B Bhattacharya, S. K Jain and S. R. Nagpaul – Basic Abstract Algebra, 2nd edition, Cambridge University Press
4. Chatterjee - Abstract Algebra , 2nd edition, PHI

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MAT5COR07-ABSTRACT ALGEBRA

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	3	1	7
III	3	2	1	6
IV	2	2	1	5
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE, ERNAKULAM

FIFTH SEMESTER

B.Sc. Mathematics

MAT5COR07-ABSTRACT ALGEBRA

Time: 3 Hours **Maximum marks:80**

Part A
(Answer TEN Questions)
Each question carries 2 marks

1. Define Klien 4- group, Draw its lattice diagram.

2. Show that identity element is unique in a group.

3. Is the group of integers cyclic? Justify your answer.

4. Show that identity permutation is an even permutation

5. Show that the sub group of a cyclic group is cyclic

6. Find all the cosets of the subgroup H = {0, 3} of the group < Z6; +6 >

7. Define isomorphism of groups

8. Show that any infinite cyclic group G is isomorphic to the group Z of integers under addition.

9. Define ideal with example

10. Define maximal normal subgroup of a group.

11. Give an example of a ring with non zero characteristic.

12. If R is a ring with unity, and N is an ideal of R containing a unit, then R = N

Part B
(Answer any SIX Questions, Each question carries 5 marks)

13. If $\sigma = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 3 & 1 & 4 & 5 & 6 & 2 \end{pmatrix}$ $\mu = \begin{pmatrix} 1 & 2 & 3 & 4 & 5 & 6 \\ 2 & 4 & 1 & 3 & 6 & 5 \end{pmatrix}$

Compute the product σ μ. State whether it is even or odd

14. State and prove Lagrange theorem.

15. Show that every permutation σ of a finite set is a product of disjoint cycles. .

16. Show by an example that the product of two left cosets need not be a left coset

17. For each $g \in G$ the mapping $i_g : G \rightarrow G$ given by $i_g x = g^{-1} x g$ is an automorphism of G.

18. Prove that every finite integral domain is a field

19. A homomorphism Φ of a group G is a one to one function if and only if the kernel of Φ is {e}

20. Give any two set of solutions of $x^2 - 5x + 6 = 0$ in Z12

21.If a ring R can be partitioned into cells with induced operation of addition and multiplication well defined and giving a ring then the cell must be precisely the left (right) cosets with respect to addition of the additive subgroup < N; + > of < R; + > where N is the cell containing 0.

Part C

(Answer any TWO Questions, Each question carries 15 marks)

22. If a group G can be partitioned into cells with the induced operation well defined and if the cells form a group, then the cell containing identity element e of G must be a sub group of G and also show that each cells must be left coset of a subgroup of G.

n

23. Define alternating group An. Show that it is a sub group of symmetric group Sn and it is of order n!/ 2 .

24. State and prove fundamental homomorphism theorem.

25. a).Check whether the set of all purely imaginary complex numbers ri ,$r \in R$ with usual addition and multiplication a ring.

b).If p is a prime, then Zp has no zero divisors.

c).If R is a ring with unity, then R has characteristic n > 0 if and only if n is the smallest positive integer such that n.1 = 0

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE)
FIFTH SEMESTER
MAT5C0R08 HUMAN RIGHTS AND MATHEMATICS FOR ENVIORNMENTAL STUDIES

4 hours/week (Total Hrs: 72) **4 credits**

Outcome/Objective

1.Environmental Education encourages their own decisions about complex environmental issues by developing and enhancing critical and creative thinking skills. It helps to foster a new generation of informed consumers, workers, as well as policy or decision makers.

2. Develops the sense of awareness among the students about the environment and its various problems and to help the students in realizing the inter-relationship between man and environment for protecting the nature and natural resources.

3.Helps the students in acquiring the basic knowledge about environment.

Text Book:
Thomas Koshy: Fibonacci and Lucas numbers with applications, John Wiley & Sons, Inc (2001).

Module I
Unit 1: Multidisciplinary nature of environmental studies

Definition, scope and importance (**2 hours**)
Need for public awareness.

Unit 2: Natural Resources:

Renewable and non-renewable resources: Natural resources and associated problems.

Forest resources:

Use and over-exploitation, deforestation, case studies.
Timber extraction, mining, dams and their effects on forest and tribal people.

Water resources:

Use and over-utilization of surface and ground water, floods, drought, conflicts over water, dams-benefits and problems.

Mineral resources:

Use and exploitation, environmental effects of extracting and using mineral resources, case studies.

Food resources:

World food problems, changes caused by agriculture and overgrazing, effects of modern agriculture, fertilizer-pesticide problems, water logging, salinity, case studies.

Energy resources:

Growing energy needs, renewable and non-renewable energy sources, use of alternate energy sources, Case studies.

Land resources:

Land as a resource, land degradation, man induced landslides, soil erosion and desertification.

Role of individual in conservation of natural resources. Equitable use of resources for sustainable lifestyles. **(10 hours)**

Unit 3: Ecosystems

Concept of an ecosystem

Structure and function of an ecosystem

Producers, consumers and decomposers

Energy flow in the ecosystem

Ecological succession

Food chains, food webs and ecological pyramids.

Introduction, types, characteristic features, structure and function of the given ecosystem: -Forest ecosystem

(**6 hours**)

Module II

Unit 1: Biodiversity and its conservation

Introduction

Biogeographical classification of India

Value of biodiversity: consumptive use, productive use, social, ethical, aesthetic and option values.

India as a mega-diversity nation

Hot-sports of biodiversity

Threats to biodiversity: habitat loss, poaching of wildlife, man-wildlife conflicts

Endangered and endemic species of India

(**8 hours**)

Unit 2: Environmental Pollution

Definition

Causes, effects and control measures of: -

Air pollution

Water pollution

Soil pollution

Marine pollution

Noise pollution

Thermal pollution

Nuclear hazards

Solid waste Management: Causes, effects and control measures of urban and industrial wastes.

Role of an individual in prevention of pollution

Pollution case studies

Disaster management: floods, earthquake, cyclone and landslides. (**8hours**)

Unit 3: Social Issues and the Environment

Urban problems related to energy

Water conservation, rain water harvesting, watershed management

Resettlement and rehabilitation of people: its problems and concerns, Case studies

Environmental ethics: Issues and possible solutions

Climate change, global warming, acid rain, ozone layer depletion, nuclear accidents and holocaust, Case studies

Consumerism and waste products

Environment Protection Act

Air (Prevention and Control of Pollution) Act

Water (Prevention and control of Pollution) Act

Wildlife Protection Act

Forest Conservation Act

Issues involved in enforcement of environmental legislation

Public awareness (**10 hours**)

Module III: Fibonacci Numbers in nature

The rabbit problem, Fibonacci numbers, recursive definition, Lucas numbers, Different types of Fibonacci and Lucas numbers. Fibonacci numbers in nature: Fibonacci and the earth, Fibonacci and flowers, Fibonacci and sunflower, Fibonacci, pinecones, artichokes and pineapples, Fibonacci and bees, Fibonacci and subsets, Fibonacci and sewage treatment, Fibonacci and atoms, Fibonacci and reflections, Fibonacci, paraffins and cycloparaffins, Fibonacci and music, Fibonacci and compositions with 1's and 2's.

(10 hours)
Text 1 Chapters 2 & 3 (excluding Fibonacci and poetry, Fibonacci and electrical networks)

Module IV: Golden Ratio

The golden ratio, mean proportional, a geometric interpretation, ruler and compass construction,

Euler construction, generation by Newton's method. The golden ratio revisited, the golden ratio and human body, golden ratio by origami, Differential equations, Gattei's discovery of golden ratio, centroids of circles, **(8 hours)**

Text 1: Chapters 20, 21

Module V: Human rights

Unit1
Human Rights– An Introduction to Human Rights, Meaning, concept and development, Three Generations of Human Rights (Civil and Political Rights; Economic, Social and Cultural Rights).

Unit-2
Human Rights and United Nations – contributions, main human rights related organs - UNESCO, UNICEF, WHO, ILO, Declarations for women and children, Universal Declaration of Human Rights.

Human Rights in India – Fundamental rights and Indian Constitution, Rights for children and women, Scheduled Castes, Scheduled Tribes, Other Backward Castes and Minorities

Unit-3
Environment and Human Rights - Right to Clean Environment and Public Safety: Issues of Industrial Pollution, Prevention, Rehabilitation and Safety Aspect of New Technologies

such as Chemical and Nuclear Technologies, Issues of Waste Disposal, Protection of Environment

Conservation of natural resources and human rights: Reports, Case studies and policy formulation. Conservation issues of western Ghats- mention Gadgil committee report, Kasthurirengan report. Over exploitation of ground water resources, marine fisheries, sand mining etc.

Internal: Field study

Visit to a local area to document environmental grassland/ hill /mountain

Visit a local polluted site – Urban/Rural/Industrial/Agricultural Study of common plants, insects, birds etc

Study of simple ecosystem-pond, river, hill slopes, etc

(Field work Equal to 5 lecture hours)

References

1. Bharucha Erach, Text Book of Environmental Studies for undergraduate Courses. University Press, IInd Edition 2013 (TB)Clark.R.S., Marine Pollution, Clanderson Press Oxford (Ref)
2. Cunningham, W. P. Cooper, T. H. Gorhani, E & Hepworth, M.T.2001Environmental Encyclopedia, Jaico Publ. House. Mumbai. 1196p (Ref)
3. Dc A.K. Environmental Chemistry, Wiley Eastern Ltd.(Ref)
4. Down to Earth, Centre for Science and Environment (Ref)
5. Heywood, V.H & Watson, R.T. 1995. Global Biodiversity Assessment, Cambridge University Press 1140pb (Ref)
6. Jadhav.H & Bhosale.V.M. 1995. Environmental Protection and Laws. Himalaya Pub. House, Delhi 284p (Ref)
7. Mekinney, M.L & Schock.R.M. 1996 Environmental Science Systems & Solutions. Web enhanced edition 639p (Ref)
8. Miller T.G. Jr., Environmental Science, Wadsworth Publishing Co. (TB)
9. Odum. E. P 1971. Fundamentals of Ecology. W.B. Saunders Co. USA 574p (Ref)
10. Rao. M. N & Datta. A. K. 1987 Waste Water treatment Oxford & IBII Publication Co.Pvt.Ltd.345p (Ref)
11. Rajagopalan. R, Environmental Studies from crisis and cure, Oxford University Press, Published: 2016 (TB)
12. Sharma B.K., 2001. Environmental Chemistry. Geol Publ. House, Meerut (Ref)
13. Townsend C., Harper J, and Michael Begon, Essentials of Ecology, Blackwell Science (Ref)
14. Trivedi R.K., Handbook of Environmental Laws, Rules Guidelines, Compliances and Stadards, Vol I and II, Enviro Media (Ref)

15. Trivedi R. K. and P.K. Goel, Introduction to air pollution, Techno-Science Publication (Ref)
16. Wanger K.D., 1998 Environmental Management. W.B. Saunders Co. Philadelphia, USA 499p (Ref)
17. (M) Magazine (R) Reference (TB) Textbook

Human Rights

1. Amartya Sen, The Idea Justice, New Delhi: Penguin Books, 2009.
2. Chatrath, K. J.S., (ed.), Education for Human Rights and Democracy (Shimla: Indian Institute of Advanced Studies, 1998)
4. Law Relating to Human Rights, Asia Law House, 2001. Shireesh Pal Singh, Human Rights Education in 21st Century, Discovery Publishing House Pvt. Ltd, New Delhi,
5. S.K. Khanna, Children And The Human Rights, Common Wealth Publishers,1998.2011.
6. Sudhir Kapoor, Human Rights in 21st Century, Mangal Deep Publications, Jaipur,2001.
7. United Nations Development Programme, Human Development Report 2004: Cultural Liberty in Today's Diverse World, New Delhi: Oxford University Press, 2004.

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MAT5C0R08 HUMAN RIGHTS AND MATHEMATICS FOR ENVIORNMENTAL STUDIES

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions	10	6	2	18

to be answered				
Total Marks	20	30	30	80

B.Sc. DEGREE EXAMINATION - Model Question Paper
SEMESTER V
Core Course – Mathematics
MAT5C0R08 – HUMAN RIGHTS AND MATHEMATICS FOR ENVIRONMENTAL STUDIES

Time: 3hours Maximum Marks :80

PART A

(Answer any **ten** questions. Each question carries 2 marks.)

1. What is food web?
2. Give a note on energy flow in the ecosystem.
3. What do you mean by water resource?
4. What is incineration?
5. What is red database?
6. Explain the relationship between Fibonacci number and total number of bees in generation *n* where $n \geq 1$.
7. Define Luca's sequence.
8. Generate golden ratio by Newton's method.
9. Discuss the ratio of consecutive numbers in Fibonacci series and its limit as n tends to infinity.
10. Illustrate the origami method to obtain the golden ratio.
11. What is information by severance?
12. What is RTI ACT 2005?

(10×2=20)

PART B

(Answer any **six** questions. Each question carries 5 marks).

13. Differentiate between renewable and non-renewable natural resources.
14. Explain the three functional or metabolic group of ecosystem.
15. What are the features of sustainable energy development?
16. Explain the different mode and measures for water conservation.
17. (a) Draw genealogical tree of a drawn in the eight generation
    (b) Find the topological index of paraffin hexane.
18. Prove that $L_k = F_{k-1} + F_{k+1}$ for all k Є N.
19. Evaluate the sum $\sqrt{1-\sqrt{1-\sqrt{1-\cdots}}}$
20. Discuss Gattei 's discovery of golden ratio.
21. Explain the rights for women and children.

(6×5=30)

PART C

(Answer any **two** questions. Each question carries 15 marks.)

22. Explain in detail the scope and importance of environmental studies.
23. Write an essay on disaster management.
24. Explain the relationship between Fibonacci numbers and economic solution of sewage treatment.
25. (a) Explain the importance of sacred ratio in the construction of Great Pyramid.

    (b) Is $\boldsymbol{\alpha} : 1 = 1 : \frac{1}{\boldsymbol{\alpha}}$? Why?

(2×15=30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE 9)
SIXTH SEMESTER
MAT6COR09-REAL ANALYSIS

5 hours/week **80 marks**

Outcome/Objective

- Identify continuous functions and uniform continuity.
- Apply Mean value theorem and Taylors theorem
- Understand the concept of Riemann integration and uniform convergence of sequence and series of functions.

Text Book: Introduction to Real Analysis – Robert G Bartle and Donald R Sherbert (3rd Edition) John Wiley & Sons, In 2007

MODULE I: CONTINUOUS FUNCTIONS (20 hours)

Continuous Functions, Combinations of Continuous Functions, Continuous Functions on Intervals, Uniform continuity.
(Chapter 5: Sections 5.1,5.2,5.3,5.4.)

MODULE II: DIFFERENTIATION (25 hours)

The Derivative, The Mean Value Theorem, L' Hospital Rules, Taylor's Theorem
(Chapter 6: Sections 6.1,6.2,6.3,6.4.1,6.4.2,6.4.3)

MODULE III: THE REIMANN INTEGRAL (25 hours)

The Riemann Integral, Riemann Integrable Functions, The Fundamental Theorem
(Chapter 7: Sections 7.1,7.2,7.3)

MODULE IV: SEQUENCES AND SERIES OF FUNCTIONS (20 hours)

Point wise and Uniform Convergence, Interchange of Limits, Series of Functions.
(Chapter 8: Sections 8.1,8.2, Chapter 9: Section 9.4.1 to 9.4.6)

References:

1. Richard R Goldberg - Methods of real Analysis, 3rd edition, Oxford and IBM Publishing Company (1964)
2. Shanti Narayan - A Course of Mathematical Analysis, S Chand and Co. Ltd (2004)
3. Elias Zako - Mathematical Analysis Vol 1, Overseas Press, New Delhi (2006)
4. J.M Howie - Real Analysis, Springer 2007.
5. K.A Ross- Elementary - Real Analysis, Springer, Indian Reprints.
6. S.C Malik, Savitha Arora – Mathematical Analysis, Revised second Edition

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MAT6COR09-REAL ANALYSIS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	4	2	1	7
III	3	4	1	8
IV	1	1	1	3
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE (AUTONOMOUS) ERNAKULAM
MODEL QUESTION PAPER B.SC DEGREE (CBCSS) EXAMINATION
MATHEMATICS CORE
SIXTH SEMESTER
MAT6COR09 – REAL ANALYSIS

Time: 3 Hour **Maximum: 80 Marks**

PART A

(Answer any 10 questions. Each carries 2 marks)

1. Define differentiability of a function f at a point c on its domain.
2. State Darboux's theorem on differentiability.
3. Give an example of a non-integrable function.
4. If f: [a, b]→R is integrable and f(x)≥0 ,for all xϵ[a, b], then prove that $\int_a^b f \geq 0$.
5. Give an example to show that composition of two integrable functions need not be integrable.
6. Define Uniform Continuity of a function f defined on a subset of $\mathbb{R}$
7. If f: I→$\mathbb{R}$ has a derivative at c ϵI, then show that f is continuous at c.
8. If f is continuous on [a, b] and differentiable on (a, b) and $f^I(x)$ =0 for all x ϵ (a, b) then prove that f is constant on [a, b].
9. Show that every constant function is integrable.
10. If f, g are integrable on [a, b] and f(x)≤g(x) for all x ϵ [a, b], then show that $\int_a^b f \leq \int_a^b g$.
11. If f: I→$\mathbb{R}$ is bounded and P and Q are partitions of I such that Q is a refinement of P then prove that L(P, f) ≤ L(Q ,f) and U(Q ,f)≤ U(P, f).
12. State and prove Abel's test.

Part-B

(Answer any 6 questions. Each question carries 5 marks)

13. State and prove Rolle's theorem.
14. Use Taylor's theorem with n=2 to approximate $\sqrt[3]{1+x}$, x>-1.
15. Show that the function f(x)=x^2 is integrable on [0,1].
16. State and prove Riemann's criterion for integrability.

17. Show that if f is a continuous function defined on [a,b] then f is integrable on [a, b].

18. State and prove Weierstrass M-test.

19. Show that if $f: A \to R$ is a lipschitz function, show that f is uniformly continuous on A

20.If f is a bounded continuous function defined on a closed and bounded interval I, then prove that f is uniformly continuous on I.

21.State and prove chain rule of differentiation.

Part C

(Answer any two. Each question carries 15marks)

22.State and prove Taylor's theorem.

OR

23. State and prove first form of fundamental theorem of calculus.

24.State and prove Cauchy Criterion for uniform convergence of sequence of functions

OR

25. Let I be an interval and let f: I→R be continuous on I. If $\alpha < \boldsymbol{\beta}$ are numbers in I such that f($\boldsymbol{\alpha}$)<0<f($\boldsymbol{\beta}$) or f($\boldsymbol{\alpha}$)>0>f($\boldsymbol{\beta}$), then prove that there exist a number c ϵ ($\boldsymbol{\alpha}$, $\boldsymbol{\beta}$) such that f(c)=0.

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B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 10)
SIXTH SEMESTER
MAT6COR10-COMPLEX ANALYSIS

5 hours/week **80 marks**

Outcome/Objective

- Conceive the concept of analytic functions and will be familiar with the elementary complex functions and their properties
- Familiarize theory and techniques of complex integration

Text book:
James Ward Brown& Ruel. V. Churchill- Complex variables and applications (8^{th} edition)

Module 1 **(30 hours)**

Analytic functions: Functions of a complex variable-limits-theorems on limits-continuity-derivatives-differentiation formulas-Cauchy-Riemann equations-sufficient condition for differentiability-analytic functions examples-harmonic functions.

Elementary functions: Exponential function –logarithmic function –complex exponents –trigonometric functions- hyperbolic functions.

Module 2 **(25 hours)**
Integrals: Derivatives of functions –definite integrals of functions –contours –contour integrals –some examples –upper bounds for moduli of contour integrals –antiderivates –Cauchy-Goursat theorem (without proof)- simply and multiply connected domains- Cauchy's integral formula-an extension of Cauchy's integral formula(without proof)- Liouville's theorem and fundamental theorem of algebra

Module 3 **(15 hours)**
Series: Convergence of sequences and series -Taylor's series (without proof)-examples- Laurent's series (without proof)-examples.

Module 4 **(20 hours)**
Residues and poles: Isolated singular points –residues –Cauchy's residue theorem –three types of isolated singular points-residues at poles-examples –evaluation of improper integrals-example –

improper integrals from Fourier analysis –Jordan’s lemma (statement only) –definite integrals involving sines and cosines

SECTIONS

Chapter2-sections12,15,16,18to22,24,25,26.

Chapter3-sections29,30,33to35.

Chapter4–sections37to41,43,44, 46 and 48to53.

Chapter5–sections55to60&62.

Chapter6-sections68to74(except71).

Chapter7–sections78to81&85.

Reference:

1. Lars V. Ahlfors - Complex Analysis – An Introduction to the Theory of Analytic Functions of one Complex Variables (4th edition), (McGRAW-HILL)
2. B. Choudhary -The Elements of Complex Variables.
3. A. David Wunsch – Complex Analysis with Applications (Pearson)

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MAT6COR10-COMPLEX ANALYSIS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	7
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S) EXAMINATION, MODEL QUESTION PAPER
Fifth Semester
Core Course-Mathematics
MAT6COR10-COMPLEX ANALYSIS
(2020 Admission onwards)

Time: 3hours Maximum:80marks

Part A

(Answer any **Ten** questions. Each question carries **2** marks)

1. Show that $\exp(2 \pm 3\pi i) = -e^2$
2. Find $\frac{d}{dz}(2z^2 + i)^2$
3. Show that a function $f(z) = u + iv$ is analytic in a domain D if and only if v is harmonic conjugate of u
4. Identify types of singularity at 0 for $f(z) = \frac{(1-C\text{os}\, z)}{z^2}$
5. Show that composition of continuous functions is continuous
6. If $|f(z)|$ is a constant, then prove that $f(z)$ must be constant
7. Show that $\lim_{z \to 0} \frac{z}{\bar{z}}$ does not exist
8. State and prove Morera's Theorem
9. State and prove Liovilles theorem
10. State Laurent's theorem
11. Find the order of pole and residue at $z = i$ for the function $f(z) = \frac{z^3+2z}{(z-i)^3}$
12. Using Cauchy Residue theorem evaluate $\int_{|z|=2} \frac{5z-2}{z(z-1)}$

(10x2=20)

Part B

(Answer any **Six** questions. Each question carries **5** marks)

13. Show that the existence of the derivative of a function at a point implies the continuity of the function at that point.
14. Show that $Log(i^3) \neq 3Log i$
15. State and prove Fundamental theorem of algebra
16. Let C be the arc of the circle $|z| = 2$ from z= 2 to z=2i that lies in the first quadrant. Without evaluating the integral show that $\left| \int_C \frac{z+4}{z^3-1} dz \right| \leq \frac{6\pi}{7}$
17. Evaluate $\int_{|z|=3} \frac{dz}{z^2+1}$
18. Give two Laurent series expansion in powers of z for the function $f(z) = \frac{1}{z^2(1-z)}$ and specify the regions in which the expnsions are valid

19. Prove that isolated singular point z_0 of a function f is a pole of order m if and only if $f(z) = \frac{\varphi(z)}{(z-z_{0)}{}^{m}}$ where $\varphi(z)$is analytic and nonzero at z_0

20. Using Residue theorem evaluate $\int\limits_{|z|=2} \frac{dz}{z^2 - 1}$

21. State and prove Cauchy residue theorem (6x5=30)

Part C

(Answer any **Two** questions. Each question carries 1**5** marks)

22. State and prove necessary and sufficient conditions of Cauchy-Reimann equations

OR

23. State and prove Cauchy-Integral Formula. Also show that $\int\limits_{C} \frac{dz}{z} = 2\pi i$ where C is any simple closed contour surrounding origin

24. (a) State Taylors theorem

(b)Expand $f(z) = \frac{-1}{(z-1)(z-2)}$ as a power series in $|z| < 1$ and $1 < |z| < 2$

(c)Find the Laurent series of $f(z) = \frac{1}{(z-2)}$ valid for $|z| > 2$

OR

25. (a)Evaluate $\int_0^{2\pi} \frac{d\theta}{5+4cos\theta}$

(b) Evaluate $\int_0^{\infty} \frac{dx}{x^2+1}$

(2x15=30)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CORE COURSE 11)
SIXTH SEMESTER
MAT6COR11- TRANSFORMS AND SPECIAL FUNCTIONS

5 hours/week **80 marks**

Outcome/Objective

- Familiarize different type of transforms
- Able to solve equations using transform
- Familiarize some special functions

Text book:

1. Erwin Kreyszig - Advanced Engineering Mathematics- 8^{th} edition.
2. B. S. Grewal – Higher Engineering Mathematics – 43^{rd} edition.

Module I **(30 hours)**
Laplace Transforms

Laplace Transform, Inverse Transform, Linearity, Shifting, Transforms of Derivatives and Integrals, Differential equations, Unit Step functions, Second shifting theorem, Dirac's delta function, differentiation and integration of transforms, Convolution, integral equations, partial fractions, Differential Equations. (Chapter 5- 5.1-5.6)

Module II **(20 hours)**
Fourier Transforms
Fourier sine and cosine transforms, Fourier transform, Table of transform, Problems relating to Fourier transform (Chapter 10- 10.9,10.10,10.11)

Module III
Z-Transforms **(20 hours)**

Introduction, Definition, Some standard Z-Transforms, Linearity property, Damping rule, Some Standard results, Shifting U_n to the right, Multiplication by n, Two basic Theorems, Some useful Z-Transforms, Some useful Inverse Z-Transforms, Convolution Theorem, Convergence of Z-Transforms, Two-sided Z-Transforms of u_n is defined by, Evaluation of Inverse Z-Transforms, Application to difference equations. (Chapter 23- 23.1-23.16)

Module IV
Beta & Gamma Functions **(20 hours)**

Beta Function, Gamma Function, Relation between Beta & Gamma Function, Elliptical Integrals, Error function or Probability Integral.
(Chapter 7- 7.14- 7.18)

Reference:

1. Erwin Kreszig – Advanced Engineering Mathematics, VIII ed.
2. N.P Bali, Dr. Manish Goyal – A Textbook of Engineering Mathematics – 8th edition

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MAT6COR11- TRANSFORMS AND SPECIAL FUNCTIONS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	3	1	8
II	2	2	1	5
III	4	2	1	7
IV	2	2	1	5
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.) EXAMINATION, MARCH 2019
Model Question Paper
Sixth Semester
Core Course: Mathematics
MAT6COR11-TRANSFORMS AND SPECIAL FUNCTIONS
(2016 Admission- Regular)

Time: Three Hours Maximum: 80 Marks

Part A

(Answer any **ten** questions. Each question carries **2** marks)

1. Show that the Laplace transform of $e^{\omega t} = \frac{1}{s-\omega}$.
2. Find the Laplace transform of t^a , *a > 0.*
3. Find the Laplace transform of $(1 + te^{-t})^3$.
4. Find the inverse Laplace transform of $\frac{1}{s(s-4)}$.
5. Find the Fourier sine transform of the function $f(x) = \begin{cases} k, 0 < x < a \\ 0,\ x > a \end{cases}$
6. Find the Fourier cosine transform of $f(x) = e^{-ax}$, where $a > 0$.
7. Find the inverse Z transform of $\frac{2z^2 + 3z}{(z+2)(z-4)}$.
8. Show that √(*n*) = $\int_0^1 (log\frac{1}{y})^{n-1}$dy , *n>0.*
9. Show that $Z\left(\frac{1}{n!}\right) = e^{\frac{1}{z}}$
10. Show that $Z(n^p) = -z\frac{d}{dz}Z(n^{p-1})$, where p is a positive integer.
11. Express the following integrals in terms of Gamma function $\int_0^{\frac{\pi}{2}} \sqrt{tan\theta}\, d\theta$.
12. Show that $\Gamma(n) = \int_0^1 (log\frac{1}{y})^{n-1} dy$

(10 x 2 = 20)

Part B

(Answer any **six** questions. Each question carries **5** marks)

13. Find the inverse Laplace transform of $\frac{s+s^2}{(s^2+1)(s^2+2s+2)}$.
14. Find the Laplace transform of $(\sqrt{t} + \frac{1}{\sqrt{t}})^3$.
15. If $L\big(f(t)\big) = F(s)$, show that $L\big(t^n f(t)\big) = (-1)^n \frac{d^n}{ds^n}(F(s))$ where n= 0, 1, 2, …
16. Find the Fourier transform *f(x)* = $\begin{cases} 1 - x^2 & if\ |x| < 1 \\ 0 & if\ \ |x| > 1 \end{cases}$ and hence find the value of $\int_0^\infty \frac{(sint)^4}{t^4}$d*t*.
17. Using Fourier integrals. Show that $\int_0^\infty \frac{sin\pi\lambda sin\lambda x}{1-\lambda^2} d\lambda = \begin{cases} \frac{\pi}{2} sinx\ \ for\ 0 \le x \le \pi \\ 0 \qquad for\ \ x > \pi \end{cases}$
18. Show that Z($\frac{1}{n!}$) =$e^{\frac{1}{s}}$. Hence evaluate Z($\frac{1}{(n+1)!}$) and Z($\frac{1}{(n+2)!}$)
19. Using the Z transform solve u_{n+2} - 2u_{n+1} + u_n = 3*n* + 5

20. Evaluate $\beta(\frac{7}{2}, \frac{-1}{2})$

21. Express $\int_0^{\frac{\pi}{6}} \frac{dx}{\sqrt{sinx}}$ in terms of elliptic integral.

(6 x 5 = 30)

Part D

(Answer any **two** questions, selecting one from each bunch.
Each question carries **15** marks)

22. (a) Find the Laplace transforms of i) *tsin3tcos2t* ii) $\sqrt{t}e^{3t}$.
    (b) Solve by the method of transform the equation $y''' + 2y'' - y' - 2y = 0$ where $y=1$, $y'= 2$, $y''= 2$ at = 0

OR

23. (a). Find the Fourier transform of *f(x)* = $\begin{cases} 1 - x^2 & if\ |x| < 1 \\ 0 & if\ |x| > 1 \end{cases}$.
    (b). State and prove convolution theorem for Fourier Transform.

24. (a) Solve y_{n+2} + 6y_{n+1} + 9y_n - 2^n with y_0 = y_1 = 0, using Z transform.
    (b) Find the Z transform
    i) $(n+1)^2$
    ii) sin(3n+5)

OR

25. Derive the relation between Beta and Gamma functions.

(2 x 15 =30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS (CORE COURSE)
SIXTH SEMESTER
MAT6COR12-LINEAR ALGEBRA

5 hours/week
Outcome/Objective

80 marks

- familiarize the concepts of basis and dimension of the Vector spaces
- understand Linear Transformations

Text Book:

1. Richard Bronson, Gabriel B. Costa - Linear Algebra An Introduction (Second Edition), Academic Press 2009, an imprint of Elsevier.

Module I **(10 hours)**
Matrices
L-U decomposition and properties of R^n.
(Section 1.6-1.7 of text 1)

Module II **(30 hours)**
Vector spaces:
Vectors, Subspace, Linear Independence, Basis and Dimension, Row Space of a Matrix, Rank of a matrix
(Chapter – 2 Sections 2.1, 2.2, 2.3, 2.4, 2.5 and 2.6 of text 1)

Module III
Linear Transformations **(30 hours)**

Functions, Linear Transformations, Matrix Representations, Change of Basis, Properties of Linear Transformations.
(Chapter –3 Sections 3.1, 3.2, 3.3, 3.4, 3.5 of text 1)

Module IV
Diagonalization of matrices **(20 hours)**

Eigen values, eigen vectors, properties of Eigen values and eigen vectors, Diagonalization of matrices, Exponential matrices**.**
(Section 4.1-4.4 of text 1)

Reference:

1 I. N. Herstein – Topics in Algebra , Wiley India
2 Harvey E. Rose - Linear Algebra, A Pure Mathematical Approach, Springer
3 Devi Prasad, - Elementary Linear Algebra, Narosa Publishing House

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MAT6COR12-LINEAR ALGEBRA

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

BSc DEGREE END SEMESTER EXAMINATION

MODEL QUESTION PAPER

SEMESTER **– 6: BSc MATHEMATICS (CORE COURSE)**

COURSE: **MAT6COR12– LINEAR ALGEBRA AND METRIC SPACES**

Time: Three Hours Max. Marks: 80

Part A

(Answer all 10 questions. Each question carries 2 mark)

1. Define linear independence and linear dependence of a vector space.

2. Show that subset of a vector space consisting of the single vector **zero** is linearly dependent?

3. Define basis of a vector space.

4. If $L : R^n \to R^m$ is defined as $L(u) = \mathrm{Au}$ for an $\mathrm{m} \times \mathrm{n}$ matrix A then show that L is linear.

5. Define kernel of a linear transformation with an example.

6. Define nullity and rank of a linear transformation.

7. Determine whether $u = [1 \quad 2 \quad 3]$ is a linear combination of $v_1 = [1 \quad 1 \quad 1]$, $v_2 = [2 \quad 4 \quad 0]$ and $v_3 = [0 \quad 0 \quad 1]$?

8. Determine whether the set $\{[1 \quad 1 \quad 0], [0 \quad 1 \quad 1], [1 \quad 0 \quad 1]\}$ form a basis for ?

9. Determine the row rank of .

10. Prove that empty set and the full space **X** are open sets.

11. Determine whether the transformation is linear if is defined by all real numbers a and b.

12. A Linear transformation has the property that and . Determine for any vector .

Part B

(Answer any 6 questions. Each question carries 5 marks)

13. Show that image of a linear transformation is a subspace of .

14. Prove that Cantor set is closed.

15. If is an eigen value of **A** then prove that its inverse is also an eigen value of .

16. Determine whether is diagonalizable.

17. Find bases for the eigen space of .

18. Prove that If is a basis for a vector space **V** then any set containing more than n vectors is linearly dependent.

19. Find a basis for the span of the vectors in $\{t^3+3t^2, 2t^3+2t-2, t^3-6t^2+3t-3, 3t^2-t+1\}$.

20. Find the matrix representation for the linear transformation defined by

with respect to the standard basis

21. Identify the kernel and the image of the linear transformation defined by

for all real numbers a, b and c.

Part C

(Answer all 2 questions. Each question carries 15 marks)

22. (a) Determine whether is a vector space under regular addition and scalar multiplication. (b) Prove that additive inverse of any vector in a vector space is unique?

OR

23. Let **T** be a linear transformation from an n-dimentional vector space **V** into **W** and let be a basis for the kernel of T. If this basis is extended to a basis for V, then prove that is a basis for the image of T.

24. For any matrix **A,** Prove tha**t** row rank of **A** equals colu**mn r**a**nk of A.**

OR

25. Prove that eigenvectors of matrix corresponding to distinct eigen values are linearly independent.

B.Sc. DEGREE PROGRAMME

MATHEMATICS (CHOICE BASED PAPER -I)
FIFTH SEMESTER
MAT5CBP01 - NUMERICAL ANALYSIS

5 hours/week **80 marks**

Outcome/Objective

- Use numerical methods to find missing values of data.
- Solve differential equation using numerical methods.
- Apply numerical methods to solve linear algebra

Textbook

1. S. S. Sastry – Introductory methods of Numerical Analysis Vth edition

Module I **(15 hours)**

Numerical Analysis: Bisection Method, Method of False position, Iteration Method, Newton - Raphson Method , Ramanujan's method, secant method (Sections 2.2, 2.3, 2.4, 2.5, 2.6 &2.7 of the text)

(15 hours)

Module II

Interpolation: Finite differences, Differences of a polynomial, Newton's Formulae for Interpolation, Central Difference

Interpolation Formulae, Interpolation with unevenly spaced points, Divided Differences and Their Properties

(Chapter 3 section 3.3, 3.5-3.7,3.9.1,3.10 of text)

(30hours)

Module III

Numerical differentiation and Integration: Numerical differentiation-errors in Numerical differentiation, Differentiation Formulae with Function Values, Numerical integration-Trapezoidal Rule, Simpson's 1/3 rule, Simpson's 3/8 rule

(chapter 6-6.1,6.2,6.2.1,6.2.3, 6.4-6.4.1,6.4.2,6.4.3 of text)

Module IV **(30hours)**

Numerical Linear Algebra: Solution of system of linear equations using iterative methods (Chapter 7 Sections 7.1 and 7.6)

Numerical solution of ordinary equation: Solution by Taylor's method, Picard's method of successive Approximations, Euler's method, Error Estimates for the Euler method, Modified Euler's method. Runge-Kutta Method (Chapters 8 section 8.1,8.2,8.3,8.4,8.4.1,8.4.2.8.5 of text 2)

References:

1. B.S. Grewal, Higher Engineering Mathematics
2. M.K.Jain,S.R.K. Iyenkar and R.K. Jain, Numerical Methods for scientific and Engineering Computation
3. Erwin Creyszig – Advanced Engineering Mathematics

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MAT5CBP01 - NUMERICAL ANALYSIS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S) EXAMINATION
MODEL QUESTION PAPER
Fifth Semester
Core Course-Mathematics
MAT5CBP01-NUMERICAL ANALYSIS
(2020 Admission onwards)

Time: 3hours
Maximum:80marks

Part A

(Answer any **Ten** questions. Each question carries **2** marks)

1. Explain Regula falsi method
2. Evaluate $\Delta^n(e^x)$,interval of differencing being unity
3. Find an iteration formula used to find root of the equation $xsinx + cosx = 0$
4. Find the second approximation of a real root of $x^3 - x - 1 = 0$ using bisection method
5. Show that $E = e^{hD}$ where D is the differential operator
6. Write stirlings interpolation formula
7. Write a note on errors in numerical differentiation
8. Explain Trapezoidal rule
9. Explain Gauss-Seidel method
10. Write formula for Runge-kutta second order and fourth order method
11. Using Eulers method, solve numerically the equation $y' = x + y, y(0) = 0\ for\ x = 0.4$, taking h=0.2
12. $y' = x + y^2$ with y(0)=1. Find the second approximation using Picard's method

(10x2=20)

Part B

(Answer any **Six** questions. Each question carries **5** marks)

13. Find the smallest root of the equation $f(x) = x^3 - 6x^2 + 11x - 6 = 0$ using Ramanuja's method
14. Evaluate $\sqrt{5}$ to four decimal places by Newton Raphson method
15. Derive Newtons forward difference interpolation formula
16. Show that E= $1 + \Delta\ and\ \Delta = \nabla(1 - \Delta)^{-1}$
17. Find the value of cos 1.747 using the table given below

x	1.70	1.74	1.78	1.82	1.86
Sinx	0.9916	0.9857	0.9781	0.9691	0.9584

18. Derive Simpson's (3/8) rule
19. Solve the system $\begin{array}{c} 6x + y + z = 20 \\ x + 4y - z = 6 \\ x - y + 5z = 7 \end{array}$ using Jacobi's Method
20. Using Taylor series, solve $5xy' + y^2 - 2 = 0, y(4) = 1$. Also find $y(4.1)$

21. Use Runge-Kutta method with h=0.1 to find y(0.2) given
$y' = x^2 + y^2 \; with \; y(0) = 0$

(6x5=30)

Part C

(Answer any **Two** questions. Each question carries 1**5** marks)

22. (a)Find a real root of the equation $x^3 + x^2 - 1 = 0$ on the interval [0,1] with an accuracy of .0001
(b)Find a positive root of $xe^x = 1$ correct to four decimal places by bisection method

OR

23. (a)From the following table, find the value of $e^{1.17}$ using central difference formula

x	1.00	1.05	1.10	1.15	1.20	1.25	1.30
e^x	2.7183	2.8577	3.0042	3.1582	3.3201	3.4903	3.6693

(b)Prove that n^{th} divided differences of a polynomial of n^{th} degree are constants

24. (a) Evaluate $\int_0^6 \frac{dx}{1+x^2}$ using Trapezoidal rule and Simpsons (1/3)rd rule using h=1.Also verify your answer with integration
(b) Solve the system
$$10x + 2y + z = 9$$
$$2x + 20y - 2z = -44$$
$$-2x + 3y + 10z = 22$$
using Gauss-Seidel and Jacobi's Method

OR

25. (a)Use Eulers 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 $0 \leq x \leq 0.5$
(b) Apply fourth order Runge-Kutta method to find y(0.1),given that $y' = x + y, y(0) = 1$

(2x15=30)

MATHEMATICS (CHOICE BASED PAPER -II)

MAT6CBP02-OPERATIONS RESEARCH

4 hours/week **80 marks**

Outcome/Objective

- convert a given real problem to LPP
- identify a feasible solution, a basic feasible solution, and an optimal solution using simplex method.
- identify the Transportation Problem and formulate it as an LPP and hence solve the problem
- analyze that an Assignment problem is a special case of LPP and hence solve by Hungarian method.

Text Books:

1. Operations Research- Prem Kumar Gupta, D.S.Hira (S.Chand)

Module I **(22 hours)**

Basics of Operations Research

Development of Operations Research, Scope of Operations Research, Applications of various OR techniques, Limitations of Operations Research.(Chapter 1-1.1,1.6.,1.10,1.23)

Linear Programming I

Introduction, Requirement for a linear programming problem, Assumptions in Linear Programming Models, Applications of Linear Programming Methods, Areas of Application of Linear programming, Formulation of linear programming Models, Graphical Method of solution. Some exceptional cases (Chapter 2-2.1-2.6, 2.9-2.10)

Module II **(25 hours)**

Linear Programming II: The general linear programming problem, Theory of Simplex method ,Some important definitions, Analytical method or trial and error method. The Simplex method, Artificial variable techniques, the Big M method, The two phase method, Special cases in the simplex method application.(Chapter 2-2.11-2.17)

Module III

(15 hours)

Transportation Model

Introduction, assumption And definition of the model, Matrix terminology, Formulation and solution of the transportation problem (Chapter 3-3.1-3.5)

Module IV **(10 hours)**

Assignment Model

Definition of the assignment model, Mathematical representation of the assignment model, Comparison with the transportation model, Solution of the assignment models, The Hungarian method for solution of the assignment Problems.(, Chapter 4 – 4.5-4.6)

Reference:

1. Operation Research by KantiSwarup, P. K. Gupta and Man Mohan - (Sultan Chand and Sons)
2. Problems in Operations Research by Gupta P. K. and Hira D. S. - (S. Chand)
3. Operations Research by Ravindran A., Philip D. T. and Solberg J. J. - (John Wiley and Sons)
4. B. K. Mishra , B. Sharma – Optimization Linear Programming (Ane Books)
5. Mokhtar S. Bazaraa, J. J. Jarvis, H.D. Sherali – Linear Programming and Network Flows (Wiley India)

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MAT6CBP02-OPERATIONS RESEARCH

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	3	1	8
II	3	2	1	6
III	2	2	1	5
IV	3	2	1	6
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE, ERNAKULAM
MODEL QUESTION PAPER
B.Sc. DEGREE (C.B.C.S.) EXAMINATION, MODEL QUESTION PAPER
Sixth Semester
Programme – B.Sc. Mathematics

MAT6CBP02 – OPERATION RESEARCH

Time: Three Hours Maximum: 80 Marks

Part A

*(Answer any **ten** questions. Each question carries **2** marks)*

1. Write the linear programming in standard form.

   Maximize $3x_1 + 5x_2 + 4x_3$

   Subject to $2x_1 + 3x_2 \leq 5$

   $2x_2 + 5x_3 \leq 8$

   $3x_1 + 2x_2 + 3x_3 \geq 2$

   $x_1, x_3 \geq 0, x_2$ *unrestricted in sign.*
2. What is meant by a basic feasible solution of an LP problem?
3. Write the standard form of a linear programming problem in matrix form.
4. Define slack variables and surplus variables.
5. Define degeneracy in transportation problem.
6. Mention the main steps for solving LPP by Big M method.
7. How can we solve an unbalanced assignment problem?
8. Define artificial variables.
9. Define primal and its dual LPP.
10. Define loop in a transportation array.
11. Give the mathematical formulation of an assignment problem.
12. Explain the difference between a transportation problem and an assignment problem.

(10x2=20)

Part B

*(Answer any **six** questions. Each question carries **5** marks)*

13. Explain applications and limitations of operation research techniques.
14. Solve the transportation problem

	Destination					
Sources		D1	D2	D3	D4	Supply
	S1	5	3	6	4	30
	S2	3	4	7	8	15
	S3	9	6	5	8	15
	Demand	10	25	18	7	

15. Describe the general mathematical model of linear programming problem .Give an example.

16. Consider the problem of assigning five jobs to five persons. The assignment coats are given as follows: Determine the optimum assignment schedule.

	Job					
Persons		L	M	N	O	P
	A	8	4	2	6	1
	B	0	9	5	5	4
	C	3	8	9	2	6
	D	4	3	1	0	3
	E	9	5	8	9	5

17. Find the initial feasible solution to the transportation problem given below

	D1	D2	D3	Supply
O1	2	7	4	5
O2	3	3	1	8
O3	5	4	7	7
O4	1	6	2	14
Demand	7	9	18	

18. Solve using simplex method

Maximize $2x_1 + 3x_2 + x_3$

Subject to $x_1 + x_2 - 2x_3 \leq 1$

$2x_1 + 3x_2 - x_3 \leq 2$

$x_1, x_2, x_3 \geq 0$

19. Solve graphically Minimize $5x_1 + 3x_2$

Subject to $x_1 + x_2 \geq 2$

$5x_1 + 2x_2 \geq 10$

$3x_1 + 8x_2 \geq 12$

$x_1, x_2 \geq 0$

20. Obtain the Phase I of the following LPP while doing two phase simplex method

Minimize Z = $x_1 + x_2$

Subject to $2x_1 + x_2 \geq 4$

$X_1 + 7x_2 \geq 7$

$X_1\ x_2 \geq 0$

21. Solve the LPP by big M method

Min Z = $9x_1 + 10x_2$

Subject to $x_1 + 2x_2 \geq 25$

$4x_1+3x_2 \geq 24$

$3x_1+2x_2 \geq 60$

$X_1,x_2 \geq 0$

(6x5=30)

Part C

*(Answer any **two**, selecting **one** question from each bunch.*
*Each question carries **15** marks)*

22. Solve using Graphical method

Maximize $4x_1 + 5x_2$

Subject to $2x_1 + x_2 \leq 6$

$x_1 + 2x_2 \leq 5$

$x_1 + x_2 \geq 1$

$x_1 + 4x_2 \geq 2$

$x_1, x_2, x_3 \geq 0$

OR

23. Solve using 2 phase simplex method

Minimize $2x_1 - 3x_2 + 6x_3$

Subject to $3x_1 - 4x_2 - 6x_3 \leq 2$

$2x_1 + x_2 + 2x_3 \geq 1$

$x_1 + 3x_2 - 2x_3 \leq 5$

$x_1, x_2, x_3 \geq 0$

.

24. Solve the following transportation problem to maximize profit

Profit in Rs/unit

	A	B	C	D	Supply
1	15	51	42	33	23
2	80	42	26	81	44
3	90	40	66	60	33
Demand	23	31	16	30	

OR

25. A salesman has to visit five cities A,B,C,D and E. the distances (in hundred kms) between the cities are as follows.

To city						
From city		A	B	C	D	E
	A	-	7	6	8	4
	B	7	-	8	5	6
	C	6	8	-	9	7
	D	8	5	9	-	8
	E	4	6	7	8	-

If the salesman starts from city A and has to come back to city A, which route should be select so that total distance travelled is minimum?

(2x15=30)

CHOICE BASED COURSE SYSTEM AND GRADING

(COMPLEMENTARY COURSES)

SYLLABUS

B.Sc. DEGREE PROGRAMME

MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)
FIRST SEMESTER
MAT1CMP01-DIFFERENTIAL CALCULUS, TRIGNOMETRY AND MATRICES

4 hours/week **80 marks**
Outcome/Objective

- Explain existence and fundamentals of limits and applications
- able to obtain the derivatives of functions and apply it in appropriate situations.
- Get the relation between circular and hyperbolic function.
- Use Matrices in solving system of equations

Text Books: -

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
2. Frank Ayres Jr: Matrices, Schaum's Outline Series, TMH Edition.
3. S.L.Loney: Plane Trignometry Part-II, AITBS Publishers India , 2009

Module 1 **(20 hours)**

Differential Calculus: Rates of change and limits, calculating limits using the limit laws, the precise definition of a limit, one sided limits and limits at infinity**,** derivative of a function, differentiation rules, the derivative as a rate of change, derivatives of trigonometric functions, the chain rule and parametric equations, implicit differentiation.
(Sections 2.1 – 2.4, 3.1 – 3.6 of Text 1)

Module II **(15 hours)**

Applications of Derivatives: Extreme values of functions, The Mean Value Theorem, Monotonic functions and the first derivative test. (Sections 4.1 - 4.3 of Text 1)

Module III **(17 hours)**

Trigonometry: Expansions of $\sin n\theta$, $\cos n\theta$, $\tan n\theta$, $\sin^n\theta$, $\cos^n\theta$, $\sin^n\theta \sin^m\theta$ Circular and hyperbolic functions, inverse circular and hyperbolic function, Separation into real and imaginary parts (Relevant sections in chapter 3-5 of Text 3)

Module 1V **(20hours)**

Matrices : Rank of a Matrix, Non-Singular and Singular matrices, Elementary Transformations, Inverse of an elementary Transformations, Equivalent matrices, Row Canonical form, Normal form, Elementary matrices only. Systems of Linear equations: System of non homogeneous, solution using matrices, Cramer's rule, system of homogeneous equations, Characteristic equation of a matrix; Characteristic roots and characteristic vectors. Cayley-Hamilton theorem (statement only) and simple applications (Text 2, Chapters – 5, 10, 19, 23).

Reference Books :

1. Shanti Narayan : Differential Calculus (S Chand)
2. George B. Thomas Jr. and Ross L. Finney : Calculus, LPE, Ninth edition, Pearson Education.
3. David W. Lewis - Matrix Theory (Allied).
4. Muray R Spiegel, Advanced Calculus, Schaum's Outline series.

BLUE PRINT
MAT1CMP01-DIFFERENTIAL CALCULUS, TRIGNOMETRY AND MATRICES

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	2	2	1	5
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION
MODEL QUESTION PAPER
First Semester

Complementary Course: Mathematics

MAT1CMP01 – DIFFERENTIAL CALCULUS, TRIGNOMETRY AND MATRICES

(Common for B.Sc. Chemistry and Physics)

Time: Three Hours Maximum: 80 Marks

Part A

(Answer any 10 questions. Each question carries 2 marks)

1. Define Critical point of a function. Give an example.
2. Find the derivative of the function $\frac{2x+5}{3x-2}$.
3. Evaluate $\lim_{x\to 1}\frac{x^2+x-2}{x^2-x}$.
4. Given that 1- $\frac{x}{4} \leq$ u(x) $\leq$ 1+ $\frac{x^2}{4}$, for all x $\neq$ 0. Find $\lim_{x\to 0}$u(x).
5. Identify the local extrema if any of the function f(x) = x^2(x+8).
6. Find the function f(x) whose derivative is 2x + 1 and whose graph passes through the point (0,0).
7. Show that $cosh^2x$ - $sinh^2x$ = 1.
8. Show that cosh(x+y) = coshxcoshy + sinhxsinhy.
9. If x = cosθ + isinθ, find x^4 + $\frac{1}{X^4}$ and x^4 - $\frac{1}{X^4}$.
10. State Cayley Hamilton theorem and verify it for $\begin{bmatrix}1 & 0\\0 & 2\end{bmatrix}$.
11. Find the Characteristic polynomial for the matrix $\begin{bmatrix}1 & 1 & 2\\1 & 2 & 1\\2 & 1 & 1\end{bmatrix}$.
12. Find the rank of the matrix $\begin{bmatrix}2 & 1\\12 & 6\end{bmatrix}$.

(10 x 2 = 20)

Part B

(Answer any 6 questions. Each question carries 5 marks)

13. Find a $\delta > 0$, to show that $\lim_{x\to 4}$x + 1 = 5 that works for ϵ = 0.01.
14. Show that y = $|x|$ is differentiable on (-∞,0) and (0,∞) but has no derivative at x = 0.
15. Find the intervals on which the function $x^{\frac{1}{3}}\,(x^2-4)$is increasing and decreasing and also find its local extreme values.
16. Verify Rolle's theorem for f(x) = x^2-3x+2 on yhe interval [1,2].
17. Separate into real and imaginary parts of tan(x+iy).
18. Expand $\sin^6\theta$ in a series of cosines of multiples of θ.
19. Check for consistency and solve it

$$x + y + z = 3$$
$$x + 2y + 3z = 4$$

$$x + 4y + 9z = 6$$

20. Find all eigen values for $\begin{bmatrix} 2 & -1 & 1 \\ -1 & 2 & -1 \\ 1 & -1 & 2 \end{bmatrix}$.

21. Reduce the matrix A to its normal form and hence determine its rank where A = $\begin{bmatrix} 0 & 1 & 2 & -2 \\ 4 & 0 & 2 & 6 \\ 2 & 1 & 3 & 1 \end{bmatrix}$.

(6 x 5 = 30)

Part C

(Answer any 2 questions. Each question carries 15 marks)

22. (a). Prove that $\log_{x\to 0} \sqrt{x}$ = 0.
    (b). Find derivative of y = x^2- sinx.
    (c). Find a parametrization for the line segment with endpoints (-2,1) and (3,5).
23. (a) State and prove mean value theorem.
    (b). Find the absolute extrema values of g(t) = 8t - t^4 on [-2,1].
24. (a). Separate into real and imaginary parts the quantity $\sin^{-1}(\cos\theta + i\sin\theta)$ where θ is real.
    (b). Separate into real and imaginary parts the expression cosh(α + βi)
25. Verify Cayley Hamilton theorem and hence find the inverse of the matrix $\begin{bmatrix} 1 & 1 & 2 \\ 3 & 1 & 1 \\ 2 & 3 & 1 \end{bmatrix}$.

(15 X 2 = 30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS
(COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)
SECOND SEMESTER
MAT2CMP01-APPLICATIONS OF INTEGRAL, PARTIAL DERIVATIVES AND ANALYTIC GEOMETRY

4 hours/week **80 marks**

Outcome/Objective

- Apply integrals for finding area, volume etc
- Get the idea of conic section

Text Books: -

1. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.

Pre Requisite: A quick review of indefinite integral as antiderivative. The Definite integral.
The fundamental theorem of Calculus
(Section 5.3 and 5.4 of Text -1).

Module I **(20 hours)**

Application of Integrals: Substitution and area between curves, Volumes by slicing and rotation about an axis (disc method only), Lengths of plane curves, Areas of surfaces of revolution and the theorem of Pappus (excluding theorem of Pappus) (Section 5.6, 6.1, 6.3, 6.5 of Text - 1),

Module II **(15 hours)**

Partial Derivatives: Functions of several variables (Definition only), Partial derivatives, The Chain Rule
(Sections 14.3 - 14.4 of Text 1)

Module III
(17 hours)

Multiple Integrals: Double Integrals, area of bounded region in plane only, Double Integrals in Polar form, Triple integrals in rectangular co-ordinates, Volume of a region in space (Sections 15.1, 15.2, 15.3, 15.4 of Text – 1)

Module IV **(20hours)**

Analytic Geometry: Conic sections and Quadratic equations, Classifying Conic Sections by Eccentricity, Conics and Parametric equations, polar co-ordinates, Conic Sections in Polar coordinates.
(Sections 10.1, 10.2, 10.4, 10.5, 10.8 of Text 1)

Reference Books:

1. Shanti Narayan, P. K. Mittal: Integral Calculus (S. Chand & Company)
2. Analytic Geometry Manicavachacan Pillai

BLUE PRINT
MAT2CMP01-APPLICATIONS OF INTEGRAL, PARTIAL DERIVATIVES AND ANALYTIC GEOMETRY

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	2	2	1	5
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION
MODEL QUESTION PAPER
Second Semester
Complementary Course: Mathematics
MAT2CMP01 – APPLICATIONS OF INTEGRAL, PARTIAL DERIVATIVES AND ANALYTIC GEOMETRY
(Common for B.Sc. Chemistry and Physics)

Time: Three Hours Maximum: 80 Marks

Part A

(Answer any 10 questions. Each question carries 2 marks)

1. Find the length of the curve y = $\frac{1}{3}(x^2+2)^{3/2}$ from x = 0 to x = 3.
2. Evaluate $\int (x+5)e^x dx$.
3. Find the area of the surface generated by revolving y = 12x – 2 about x-axis $0 \leq x \leq 2$.
4. Evaluate $\int_0^{\pi/6} cos^{-3}2\theta sin2\theta d\theta$.
5. Find f_x and f_y if $f(x,y) = \frac{2y}{y+cosx}$.
6. Use chain rule to find $\frac{dw}{dt}$ if $w = x^2 + y^2$, x = cost + sint ,y = cost-sint.
7. Find the centroid of the region cut from the first quadrant by the circle $x^2 + y^2 = a^2$.
8. Evaluate $\int_0^1\int_0^{3-3x}\int_0^{3-3x-y} dzdydx$.
9. Find the average value of f(x,y) = xy over the square $0 \leq x \leq 1$, $0 \leq y \leq 1$.
10. Find the focus and directrix of the parabola $y^2 = 16x$.
11. Find the equation of hyperbola with eccentricity 3/2 and directrix x = 2.
12. Find all polar coordinates of the point P(2,$\frac{\pi}{6}$).

(10 x 2 = 20)

Part B

(Answer any 6 questions. Each question carries 5 marks)

13. Find the area of the region in the first quadrant that is bounded above by y = $\sqrt{x}$ and below by the x axis and the line y = x-2.
14. Find the volume of the solid generated by revolving the ellipse $\frac{x^2}{a^2} + \frac{y^2}{b^2} = 1$ about the x-axis.
15. Find $\frac{dw}{dt}$ if $w = \ln(x^2 + y^2 + z^2)$, x = cost, y = sint , z = $4\sqrt{t}$ at t = 3.
16. Find $\frac{\partial z}{\partial u}$ and $\frac{\partial z}{\partial v}$ when u = ln2 , v = 1 if z = $5tan^{-1}x$ and $x = e^u$+ln$v$.
17. Find the polar moment of inertia about the origin of a thin plate enclosed by the cardioid r =1 + cosθ if the plate's density function is δ(x,y) = 1.
18. Evaluate $\int_0^7\int_0^2\int_0^{\sqrt{4-q^2}} \frac{q}{r+1} dpdqdr$.
19. Find the polar equation for the circle $x^2 + (y-3)^2 = 9$.
20. Find the Cartesian equation for the hyperbola centred at the origin that has focus at (3,0) and the line x = 1 is the corresponding directrix.

21. Describe the motion of the particle whose position P(x , y) at time t is given by x = sect , y = tant, $\frac{-\pi}{2} < t < \frac{\pi}{2}$.

(6 x 5 = 30)

Part C

(Answer any 6 questions. Each question carries 5 marks)

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

    (b). Find the area of the region in the first quadrant bounded by the line y = x, line x = 2, curve y = $\frac{1}{x^2}$ and the x axis.

23. (a). Find $\frac{\partial f}{\partial x}$, $\frac{\partial f}{\partial y}$ if $f(x , y) = \frac{x+y}{xy-1}$.

    (b). Find $\frac{dw}{dt}$ if w = xy +z, x = cost, y = sint, z = t. What is the derivative value at t = 0?

    (c). Find $\frac{\partial z}{\partial x}$ and $\frac{\partial z}{\partial y}$ at (1,1,1) of the equation $z^3 - xy + yz + y^3 - 2 = 0$.

24. Find the average value of F (x, y, z) = xyz over the cube bounded by the coordinate planes and planes x = 2, y = 2 and z = 2 in the first octant.

25. (a). Find the polar equation for the parabola with focus (0,0) and the directrix $r\cos(\theta - \frac{\pi}{2}) = 2$.

    (b). Find the Cartesian equation of $r^2 = -4r\cos\theta$. Describe and identify the graph.

(2 x 15 = 30)

B.Sc. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)
THIRD SEMESTER

MAT3CMP01-VECTOR CALCULUS, ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

5 hours/week **80 marks**

Outcome/Objective

- Students will be able to solve first order differential equation using the standard techniques for separable, exact, linear, homogenous or Bernoulli cases.
- Students will have the working knowledge of solving a differential equation and connecting that with the some real life applications

Text :-

1. A. H Siddiqi , P Manchanada : A first Course in Differential Equations with Application (Macmillan India Ltd 2006)
2. George B. Thomas, Jr: Thomas' Calculus Eleventh Edition, Pearson, 2008.
3. Ian Sneddon – Elements of Partial Differential Equation (Tata Mc Graw Hill)

Module I **(20 hours)**

Vector Differential Calculus : Vector Functions, Arc length and unit Tangent vector **T**, Curvature and unit Normal Vector **N**, Torsion and unit Binormal vector **B,** Directional Derivatives and Gradient Vectors**.**

(Sections 13.1, 13.3, 13.4, 13.5 and 14.5 of text 2)

Module II **(30 hours)**

Vector Integral Calculus: Line Integrals, Vector fields and Work, Circulation and Flux, Path independence, Potential Function and Conservation Fields, Green's theorem in Plane (Statement and problems only), Surface area and Surface integral, Parameterised Surface, Stoke's theorem(Statement and Problems only), the Divergence theorem and a Unified theory (Statement and simple problems only).

(Sections 16.1 to 16.8 of text 2)

Module III **(25 Hours)**

Ordinary differential equations: Exact Differential Equation, Linear Equations , Solutions by Substitutions, Equations of first order and not of first degree , First order equations of higher Degree solvable for p , Equations solvable for y , Equations solvable for x, Equations of first degree in x and y - Lagrange's and Clairaut's Equation

(sections 2.1 , 2.2 , 2.3 , 2.4 , 3.1 , 3.2 , 3.3 , 3.4 , 3.5 of text 1)

Module IV **(15 Hours)**

Partial Differential Equations: Surfaces and Curves in three dimensions, solution of equation of the form $\frac{dx}{P} = \frac{dy}{Q} = \frac{dz}{R}$.

~~O~~rigin ~~o~~f fi~~rst~~ order and second order partial differential equations, Linear equations of the first order, Lagrange's method (Chapter 1, section 1 and 3 & Chapter 2 Section 1, 2 and 4 of text3)

Reference Books:

1. Shanti Narayan, P. K. Mittal: Vector Calculus (S. Chand & Company)
2. P.P.G Dyke: An introduction to Laplace Transforms and Fourier Series (Springer 2005)
3. Harry F. Davis & Arthur David Snider: Introduction to Vector Analysis, 6th ed., Universal Book Stall, New Delhi.
4. Murray R. Spiegel: Vector Analysis, Schaum's Outline Series, Asian Student edition.
5. Merle C. Potter – Advanced Engineering Mathematics, Oxford University Press.

BLUE PRINT

MAT3CMP01-VECTOR CALCULUS, ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	2	2	1	5
II	3	2	1	6
III	4	2	1	7
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE(C.B.C.S.) EXAMINATION
Model Question Paper
Third Semester
Complementary Course – Mathematics
MAT3CMPO1- VECTOR CALCULUS, ORDINARY AND PARTIAL DIFFERENTIAL EQUATIONS
(Common for Physics Model I & III and Chemistry Model I & III)
(2016 Admission onwards- Regular/ Improvement/ Supplementary)

Time : 3 Hours Maximum : 80 Marks

Part A
(Answer any ten questions. Each question carries 2 mark)

1. Find the length of one turn of the helix $\overrightarrow{r(t)} = cost\,i + sint\,j + tk$.
2. Find the direction in which the function $f(x, y, z) = \frac{x^2}{2} + \frac{y^2}{2}$ decreases most rapidly at the point (1,1).
3. If $f(x, y, z) = 3x^2y - y^3z^2$, find the gradient field of f.
4. Find the work done by the $\vec{F} = (3x^2 - 3x) + 3zj + k$ along the straight line from (0, 0, 0) to (1, 1, 1).
5. Compute the curl $\vec{F} = xyz\,i + 3x^2yzj + 4xzk$.
6. State Green's theorem.
7. Solve $\frac{dy}{dx} = \frac{x}{y}$.
8. Check whether the equation $(xy^3 + y)dx + 2(x^2y^2 + x + y^4)dy = 0$ is exact or not.
9. Solve $\frac{dy}{dx} = y+2$.
10. Form the partial differential equation by eliminating the arbitrary function f from $z = x + y + f(xy)$.
11. Show that the directional cosines of the tangent of the point (x, y, z) to the conic $ax^2 + by^2 + cz^2 = 1$, $x + y + z = 1$ are proportional to $(by - cz, cz- ax, ax - by)$.
12. Form the partial differential equation by eliminating the constants a and b from $z = ax^2 + by^2$.

(10 × 2 = 20)

Part B
(Answer any six questions. Each question carries 5 mark)

13. Without finding $\vec{T}$ and $\vec{N}$, write the acceleration of the motion $\overrightarrow{r(t)} = (t+1)I + 2tj + t^2k$ in the form $a = a_T\vec{T} + a_N\vec{N}$ at $t=1$.
14. Find the derivative of $f(x, y) = 2xy - 3y^2$ at (5, 5) in the direction of the vector $4i + 3j$.
15. Show that $\vec{F} = (e^x cosy + yz) + (xz - e^x siny)j + (xy + z)k$ is conservative and find a potential function for it.
16. Find the outward flux of the field $\vec{F} = \frac{xi+yj+zk}{\rho^3}$, $\rho = \sqrt{x^2 + y^2 + z^2}$ across the boundary of the region D : $0 < a^2 \leq x^2 + y^2 + z^2 \leq b^2$.

17. Find the surface area of a sphere of radius a.

18. Solve $x(\frac{dy}{dx})^3$ - 12$\frac{dy}{dx}$ – 8 = 0.

19. Solve $2xy\frac{dy}{dx} - y^2 + x^2 = 0$.

20. Find the integral curve of : $\frac{adx}{yz(b-c)} = \frac{bdy}{zx(c-a)} = \frac{dz}{xy(a-b)}$.

21. Find the general integrals of $y^2p - xyq = x(z - 2y)$.

(6 × 5 = 30)

Part C

(Answer any two questions, selecting one from each bunch.
Each question carries 15 mark)

22. Find $\vec{T}, \vec{N}, k$ for the curve $\overrightarrow{r(t)} = acosti + asintj + btk, a, b \geq 0, a^2 + b^2 \neq 0$.

OR

23. Integrate $g(x, y, z) = x + y + z$ over the surface of the cube cut from the first octant $x = 2, y = 2, z = 2$.

24. Solve the following equations

a) $x(1 - x^2)\frac{dy}{dx} + (2x^2 - 1)y = ax^3$.

b) $(2x - 1)dx + (3y + 7)dy = 0$.

OR

25. a) Solve the equation $(y + zx)p - (x + yz)q = x^2 - y^2$.

b) Find the general integral of $(xp - yq) = -x^2 + y^2$.

(2 × 15 =30)

B.Sc. DEGREE PROGRAMME
MATHEMATICS (COMPLEMENTARY COURSE TO PHYSICS/CHEMISTRY)
FOURTH SEMESTER

MAT4CMP01-FOURIER SERIES, LAPLACE TRANSFORM, COMPLEX NUMBERS AND NUMERICAL METHODS

5 hours/week **80 marks**

Outcome/Objective

- Able to find the Fourier series of functions
- Able to transform the functions
- Handle numerical problem
- Get the basic idea of complex numbers

Text Books

1. Erwin Kreyszig: Advanced Engineering Mathematics, Eighth Edition, Wiley, India.
2. J.W. Brown and Ruel. V. Churchill _ Complex variables and applications, 8th edition. McGraw Hill.
3. S. S. Sastry: Introductory methods of Numerical Analysis ,4th edition (Prentice Hall)

Module I **(20 hours)**

Fourier Series: Periodic Functions, Trigonometric Series, Functions of any period p = 2L Fourier Series, Even and Odd functions, Half-range Expansions.
(Sections 10.1, 10.2, 10.3, 10.4, of Text 1 – Excluding Proofs).

Module II **(20 hours)**

Laplace Transforms: Definition, Laplace Transforms and Inverse Transforms, transforms of derivatives and integrals, Differentiation and Integration of transforms, Convolution theorem.
(Sections: 5.1 to 5.5 of Text 1)

Module III **(25 hours)**

complex numbers: Sums and products. Basic algebraic properties. Further properties. Vectors and moduli. Different representations. Exponential forms. Arguments of products and quotients. Product and powers in exponential form. oots of complex numbers. Regions in the complex plane. (Section 1 to 11 of chapter 1 of text 2.)

Module IV **(25hours)**

Numerical Methods: (Use of Non Programmable Scientific Calculator is Permitted)
Bisection Method, Methods of false position, Iteration Method , Newton Raphson Method,

Numerical solution of ordinary differential equations: Taylor series method, Picard's method, Euler's and modified Euler's method, Runge- Kutta method (section 2.1, 2.2, 2.3, 2.4, 2.5, 7.1-7.5of Text 3)

Reference:

1.B.S. Grewal -Higher Engineering Mathematics- 43rd edition
2.Srimanta Pal – Numerical Methods, Oxford University Press
3.Qazi Shoeb Ahamad, Zubir Khan – Numerical and Statistical Techniques, Ane Books

BLUE PRINT
MAT4CMP01-FOURIER SERIES, LAPLACE TRANSFORM, COMPLEX NUMBERS AND NUMERICAL METHODS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	2	2	1	5
II	4	2	1	7
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION

Model Question Paper

Fourth Semester

Complementary Course – Mathematics

MAT4CMP01 – FOURIER SERIES, LAPLACE YRANSFORM, COMPLEX NUMBERS AND NUMERICAL METHODS

(Common for Physics, Chemistry Model *I* and *III*)

(2016 Admission – Regular)

Time: Three Hours Maximum mark: 80 Marks

Part A

(Answer any **ten** question. Each question carries **2** marks)

1. Test whether the function $f(x) = x \sin x$ is even or odd.
2. Sketch the function $f(x) = x^2$, $x \epsilon [-\pi, \pi]$.
3. If $f(x) = x^3$ in $[-\pi, \pi]$ with $f(x) = f(x+\pi)$, $\forall x \epsilon R$, find a_0 in the Fourier expansion of $f(x)$.
4. Find the inverse Laplace transform of $\frac{s+2}{1+(s+2)^2}$.
5. What is the Laplace transform of tcos2t ?
6. Find the Laplace transform of the function $2e^{-4t} - t^4$.
7. Express the complex number $(\sqrt{3} + i)^7$ in the exponential form.
8. If $z_1 = -1$ and $z_2 = i$, find $\text{Arg}(z_1 z_2)$.
9. What is the multiplicative inverse of $\frac{3+4i}{2}$ in the form of a+ib?
10. Find the positive root of the equation $xe^x = 1$ which lies between 0 and 1, using Bisection method.
11. Using Taylor's method, solve the differential equation $y' = x + y$ with the initial condition $y(1) = 0$.
12. What is the Newton-Raphson formula for solving the transcendental equation $f(x) = 0$.

(10 ×2 = 20)

Part B

(Answer any **six** question. Each question carries **5** marks)

13. Find the Fourier series of $f(x)$ given by $f(x) = \begin{cases} 1, when\ 0 < x < \pi \\ -1, when\ \pi < x < 2\pi \end{cases}$ and $f(x) = f(x+2\pi)$.
14. Obtain the Fourier cosine series representation of $f(x) = \begin{cases} cosx, & 0 < x < \pi \\ 0, & \pi < x < 2\pi \end{cases}$.
15. Solve the initial value problem $y'' + y' - 6y = 1$, $y(0) = 0$, $y'(0) = 1$.
16. Find the Laplace transform of $\frac{1-e^t}{t}$.
17. Write the triangle inequality of complex numbers. Then prove that $||z_1| - |z_2|| \leq |z_1 - z_2|$, if z_1 and z_2 are complex numbers.

18. Define a domain in *C*. Sketch the set $|z - 2 + i| \leq 1$ and determine whether it is a domain or not.
19. Find a real root of the equation $x^3 + x^2 - 1 = 0$ 0n the interval [0,1] using fixed point iteration method with an accuracy of 10^{-4} . Choose $x_0 = 0.75$.
20. Solve the differential equation $y' = 1 + y^2$, subject to the condition $y = 0$ when $x = 0$, using Picard's method. Hence find the approximate value of y at $x = 0.1$.
21. Find $y(0.4)$ using Euler method, if $y' = x + y$ with initial condition $y(0) = 0$ in two steps.

(6 ×5 = 30)

Part C

(Answer any **two** questions selecting one question from each bunch .

Each question carries **15** marks)

22. Find the Fourier series expansion of $f(x) = \begin{cases} -\pi, & -\pi < x < 0 \\ x, & 0 < x < \pi \end{cases}$ and also deduce that $\boldsymbol{\frac{\pi^2}{8} = \frac{1}{1^2} + \frac{1}{3^2} + \frac{1}{5^2} + \ldots}$

OR

23. i) Find the inverse Laplace transform of $\frac{3s+1}{(s^2+1)(s-1)}$.

    ii) Solve the integral equation $y(t) = t + \int_0^t y(\tau) \sin(t - \tau)\, d\tau$.

24. i) Find the principal argument of $\frac{1}{-2-2i}$

    ii) What are the 4 roots of $-8 - 8\sqrt{3}\, i$?

OR

25. i) solve the equation $f(x) = x^3 + x - 1 = 0$, near $x = 1$, using false position method.

    ii) Given $y' = 1 + y^2$, where $y(0) = 0$, find $y(0,2)$ and $y(0,4)$ using 4^{th} order Runge-Kutta method with $h = 0.2$.

(2 × 15 = 30)

B.A. DEGREE PROGRAMME

MATHEMATICS (COMPLEMENTARY COURSE TO ECONOMICS)
THIRD SEMESTER
MAT3CME01-GRAPHING FUNCTIONS, EQUATIONS AND LINEAR ALGEBRA

6hours/week **80 marks**
Outcome/Objective

- Draw Graphs of linear equations
- Use system of equations in business and economics
- Solve system of equations using matrices

Text Books:-

1. Edward T Dowling : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)
2. Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)

MODULE I **(20hours)**

Review: Exponents, polynomials, factoring, fractions, radicals, order of mathematical operations.

Equations and Graphs: Equations, Cartesian Co-ordinate system, linear equations and graphs slopes intercepts. The slope intercept form. Determining the equation of a straight line. Applications of line equations in business and economics. (Chapter 1,2)

MODULE II **(25hours)**

Functions: Concepts and definitions- graphing functions. The algebra of functions. Applications of linear functions for business and economics.

Solving quadratic equations: Facilitating nonlinear graphing. Application of nonlinear functions in business and economics.

System of equations: Introduction, graphical solutions. Supply-demand analysis. Break-even analysis. Elimination and substitution methods. IS-LM analysis. Economic and mathematical modelling. Implicit functions and inverse functions. (Chapter 3,4)

MODULE III **(35hours)**

Linear (or Matrix) Algebra: Introduction. Definition and terms. Addition and subtraction of matrices. Scalar multiplication. Vector multiplication. Multiplication of matrices. Matrix expression of a system of linear equations. Augmented matrix. Row operation. Gaussian method of solving linear equations. Solving linear equations with. Matrix algebra: Determinants and linear independence. Third order determinants. Cramer's rule for solving linear equations. Inverse matrices. Gaussian method of finding an inverse matrix. Solving linear equations with an inverse matrix. Business and Economic applications. Special determinants. (Chapter 5,6)

MODULE IV **(28hours)**

Linear programming: using graphs**:** Use of graphs. Maximisation using graphs. The extreme point theorem. Minimisation using graphs.

(Chapter 7)

Reference Books: Taro Yamano: Mathematical Economics

BLUE PRINT

MAT3CME01-GRAPHING FUNCTIONS, EQUATIONS AND LINEAR ALGEBRA

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	2	2	1	5
II	4	2	1	7
III	4	3	1	8
IV	2	2	1	5
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.A. DEGREE (C.B.C.S.S.) EXAMINATION
Third Semester
Complementary Course – Mathematics
MAT3CME01 – GRAPHING FUNCTIONS, EQUATIONS AND LINEAR ALGEBRA
(For B A Economics)
(Regular/Improvement/Supplementary)

Time: Three Hours Maximum: 80 Marks

Part A

(Answer any 10 questions. Each question carries 2 marks.)

1. Simplify $\sqrt{169x^6y^8}$.
2. Find the slope of the line passing through the points (-2,5) and (1,-7).
3. f(x) = x^2 + 3 , g(x) = 4x – 7, find (f+g)(x).
4. Given f(x) = x^4, g(x) =x^2-3x+4. Find g(f(x)).
5. Solve for x, x^2-8x-48 = 0.
6. What is IS-LM analysis?
7. If A =$\begin{bmatrix} 2 & 7 & 8 \\ 6 & 3 & 5 \\ 1 & 4 & 9 \end{bmatrix}$, find |A|.
8. Find the dimension of the matrix A = $\begin{bmatrix} 6 \\ 13 \\ 9 \end{bmatrix}$ and find the transpose of the matrix and indicate the new dimension.
9. A = [5 12] , B = $\begin{bmatrix} 21 \\ 10 \end{bmatrix}$ find AB.
10. Find the dimension of the matrix A=$\begin{bmatrix} 6 \\ 13 \\ 9 \end{bmatrix}$ and find the transpose of the matrix and indicate the new dimension.
11. What is an objective function.
12. Draw the graph of the straight line 3x + 2y ≥ 30 and shade the required region x,y ≥ 0.

(10 x 2 = 20)

Part B

(Answer any 6 questions. Each question carries 5 marks.)

13. Find the equation for the line passing through the points (0,-2),(8,0).
14. Find x if $\frac{36}{x-5}$ - $\frac{25}{2x}$ = $\frac{26}{x-5}$.
15. Solve the quadratic equation 3x^2 - 35x + 22 = 0.
16. Find the equilibrium price P_e and quantity Q_e for the mathematical models of supply and demand.
    i) Supply: P = $\frac{1}{4}$ Q + 200
    ii) Demand: P = - $\frac{1}{2}$ Q + 800
17. Using Gaussian eliminates method solve augmented matrix

$$3x_1 + 12x_2 = 102$$

$$4x_1 + 5x_2 = 48$$

18. Use Cramer's rule to solve for the equilibrium level price $\bar{P}$ and quantity $\bar{Q}$ given
    i) Supply: $-7P + 14Q = -42$
    ii) Demand: $3P + 12Q = 90$
19. Find the inverse of the matrix $\begin{bmatrix} 1 & -1 \\ 2 & 0 \end{bmatrix}$
20. A manufacturer makes two products x_1 and x_2. The first requires 5 hours for processing, 3 hours for assembling and 4 hours for packaging. The second requires 2 hours for processing, 12 hours for assembling and 8 hours for packaging. The plant has 40 hours available for processing, 60 hours for assembling and 4 hours for packaging. The profit margin for x_1 is $7 and for x_2 is $21. Express the data in equations and inequalities necessary to determine the output mix that will maximize profits.
21. Use graphs to solve the following linear programming problems.

$$\text{Maximise } \pi = 2x_1 + 3x_2$$

Subject to

$$2x_1 + 2x_2 \leq 32$$
$$3x_1 + 9x_2 \leq 108$$
$$6x_1 + 4x_2 \leq 84$$
$$x_1, x_2 \geq 0.$$

(6 x 5 = 30)

Part C

(Answer any 2 questions. Each question carries 15 marks.)

22. (a). Solve $6(4x+5) - 3x = 19 - 2(7x + 82)$.
    (b). Find the y intercept for $5x + y = 9$.
    (c). Find the x intercept for $y = 9x - 72$.
23. Find the vertex, axes and the coordinates of the x-intercept and graph the curve $y = x^2 - 8x + 18$.
24. Using Cramer's rule, solve the system of equations.
    $4x_1 + 2x_2 + 7x_3 = 35$
    $3x_1 + x_2 + 8x_3 = 25$
    $5x_1 + 3x_2 + x_3 = 40$
25. Minimize $\Pi = 12y_1 + 20y_2$ subject to constraints
    $3y_1 + 9y_2 \geq 45$
    $4y_1 + 6y_2 \geq 48$
    $14y_1 + 7y_2 \geq 84$
    $y_1, y_2 \geq 0$
    Using graphs.

(15 x 2 = 30)

B.A. DEGREE PROGRAMME
MATHEMATICS (COMPLEMENTARY COURSE TO ECONOMICS)
FOURTH SEMESTER
MAT4CME02- CALCULUS, EXPONENTIAL AND LOGARITHMIC FUNCTIONS

6hours/week **80 marks**

Outcome/Objective

- Use derivative and integrals in concepts in Economics
- Solve optimization problem

Text Books:-

1. Edward T Dowling : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)

Module 1 ` **(30 hours)**

Differential calculus: The derivative and the rules of differentiation: limits, continuity. The slope of curvilinear function. The derivative, differentiability and continuity. Derivative notation. Rules of differentiation. Higher order derivatives. Implicit functions. Differential calculus. Uses of derivatives. Increasing decreasing functions. Concavity and convexity. Relative extrema. Inflection points. Curve sketching. Optimisation of functions. The successive derivative test. Marginal concepts in economics. Optimising economic functions of business. Relation among total, marginal and average functions.
(Chapter 9,10)

Module 1I **(22 hours)**

Exponential and logarithmic functions: Exponential functions. Logarithmic functions properties of exponents and logarithms. Natural exponential and logarithmic functions. Solving natural exponential and logarithmic functions. Logarithmic transformation of non linear functions. Derivatives of natural exponential and logarithmic functions. Interest compounding. Estimating growth rates from data points.
(Chapter 11)

Module III **(28hours)**

Integral calculus: Integration rules for indefinite integrals. Area under a curve. The definite integral. The fundamental theorems of calculus. Properties of definite integrals. Area between curves. Integration by substitution. Integration by parts. Present value of cash flow consumers and producers surplus.
(Chapter 12)

Module IV **(28hours)**

Calculus of Multivariable functions: Functions of several independent variables. Partial derivatives. Rules of partial differentiation. Second – order partial derivatives. Optimization of multivariable functions. Constrained optimization with Lagrange Multipliers. Income determination Multipliers. Optimization of multivariable functions in business and economics constrained optimization of multivariable economic functions. Constrained optimization of Cobb Douglas production functions.

(Chapter 13)

Reference Books: Taro Yamane: Mathematical Economics

BLUE PRINT

MAT4CME02- CALCULUS, EXPONENTIAL AND LOGARITHMIC FUNCTIONS

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION
MODEL QUESTION PAPER
Fourth Semester
Complementary Course – Mathematics
MAT4CME06 – CALCULUS, EXPONENTIAL AND LOGARITHMIC FUNCTIONS
(For Economics)
(2016 Admission – Regular)

Time: Three Hours
Maximum: 80 Marks

Part A

(Answer any **ten** questions. Each question carries 2 marks)

1. Find the derivative of f (x) = $\frac{5x-4}{9x+2}$.
2. If f(x) = (4x – 1)($3x^2$ + 2), find f '(x) at x = 3.
3. State product and quotient rule of differentiation.
4. Module 1 qsnt
5. Solve e^{3x} = 90.
6. Differentiate f(x) = 6$e^{4x^3 - 17}$.
7. Find the vaue of $\int e^{3x} . e^{2x} dx$.
8. Find $\int_2^5 3x^2 \, dx$.
9. Write any two properties of definite integrals.
10. A producer's MC is $\frac{x^2}{8} - x + 320$. What is the total cost of producing 2 extra units, if 6 units are currently being produced?
11. Find z_x and z_y , where z = $5x^4 + 3x^2y^5 - 9y^3$.
12. Find z_{yy} where z = $6x^4 - 17xy + 4y^2$.

(10x2 = 20)

Part B

(Answer any **six** questions. Each question carries 5 marks)

13. Find the critical values of f(x) = $2x^3 - 18x^2 + 48x - 29$ and check whether it attains relative maximum or minimum at these points.
14. What is inflection point? Draw 4 graphs showing different types of points of inflection.
15. Solve 4lnx + 9 = 30.6
16. Find the value A for a principal of P = \$3000 at rate of r = 8%, time t = 6 years when compounded (a) annually (b) semiannually.
17. Find $\int 24x^2 e^{6x} dx$.

18. Find $\int \frac{10x^2}{5x\text{^}3-8} dx$.
19. Optimize $z = -7x^2 + 88x - 6xy + 42y - 2y^2 + 4$.
20. Find all second order partial derivatives of $z = 7x^3 - 12x^2y + 2xy^2 - y^3$.
21. Find the derivative $\frac{dy}{dx}$ for the following implicit functions

(a) $9x^2 - y = 0$

(b) $5x^4 - 3y^5 - 49 = 0$.

(6x5 = 30)

Part C

(Answer any **two** questions selecting **one** question from each bunch.
Each question carries **15** marks)

22. Investigate all the successive derivatives and evaluate them at $x = 2$ for $f(x) = (8 - x)^4$.

OR

23. Construct a schedule and draw the graph for the following functions. Also observe their properties. (a) $y = 2^x$ (b) $y = \log_2 x$
24. Draw the graphs of the functions $y = 6$, $y = x^2 - 3$ and find the area between the curves from $x = -3$ to $x = 3$.

OR

25. Using Lagrange multiplier method, find the critical values of $f(x,y) = 4x^2 - 6xy + 9y^2$ subject to $2x + y = 104$.

(2x15 = 30)

B.A.(HONOURS)DEGREE PROGRAMME

SEMESTER I, CORE IV

ECH1COR04- MATHEMATICS IN ECONOMICS I (HONOURS)

6hours/week

80 marks

Outcome/Objective

1. to study basics of Set theory and properties with illustrations
2. Understand the concept of limit of a function and derivative with problems.
3. Solve linear system of equations using matrices and determinants.

Text Books:-

1. Edward T Dowling : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)
2. Taro Yamane : Mathematics for Economists

Module 1 **(25 hours)**

Set theory-set membership-set operations-Venn diagrams. Relations, functions, Concepts and definitions- graphing functions. The algebra of functions. Applications of linear functions for business and economics.

(Sections 3.1-3.4 of text 1, 1.1-1.3 ,1.6,1.7of text 2)

Module II **(25 hours)**

Limits and continuity, Continuous and discontinuous functions, Differentiable and non-differentiable functions. Derivatives -product rule-quotient rule-chain rule- differentiation of exponential, logarithmic, and implicit functions

(Sections 9.1-9.9 of text 1).

Module III **(30 hours)**

Second order derivatives-convex, concave, point of inflexion, maxima-minima, MRTS-cost functions. Integration-power rule- exponential function-by algebraic substitution-definite integral-area under a curve-consumer and producer surplus-income distribution-integration by parts (10.1-10.4,10.6,12.1-12.11 of text 1)

Module 1V **(28 hours)**

Linear algebra-systems of linear equations -scalar product- matrix operations-multiplication-transpose-determinants of order 2 and 3-cofactors-inverse-cramers rule- input-output model -IS-LM model.(Sections : 5.1-5.6,5.7,6.1-6.4,6.6,6.7 of text 1)

References

1. Chiang A C,Fundamental methods of mathematical economics, Mcgraw Hill
2. Henderson and Quandt, Micro economic theory: a mathematical approach
3. Simon and Blume, Mathematics for Econiomists:Viva –Norton student edition
4. Sydsaeter and Hammond, Mathematics for Economic Analysis,Pearson
5. Hamdy Taha, Operations Research
6. Avinash Dixit, (1990), Optimization in Economic Theory, (2nd edition)

Additional readings

1. Bertrand Russel(2012), Principles of Mathematics, Rutledge (special Indian edition)
2. Davis and Hersh(1998),The Mathematical Experience, Mariner Books.

BLUE PRINT
ECH1COR04- MATHEMATICS IN ECONOMICS I (HONOURS)

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	3	2	1	6
II	3	2	1	6
III	3	2	1	6
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJAS COLLEGE (AUTONOMOUS)
MODEL QUESTION PAPER
B.A DEGREE (C.B.C.S.S.) EXAMINATION
First Semester Economics (Hons)
ECH1COR04 - Mathematics in Economics I

Time :3 Hours Maximum Marks :80

Part A

(Answer any 10 questions. Each has 2 marks.)

1. If A = {1,2,3,4,5} and B = {1,2,3}. Find A-B and B – A
2. Write the negation of the proposition "sun is shining"
3. Evaluate: $\lim_{x\to 4} 3x^2-5x+9$
4. Find the value of $\int e^{2x}dx$
5. If y= $\sqrt{(x^4+8x^2+1)}$ find dy/dx
6. Evaluate $\lim_{x\to 3}(x^2-9)/(x-3)$
7. Find the partial derivative Z_{xy} and z_{yx} for the function $Z = 3x^2+12xy+5y^2$
8. Evaluate $\int_1^4(x^{-1/2} + 3x^{1/2})dx$.
9. Evaluate $\int(6x-11)^{-5}dx$
10. If A = $\begin{pmatrix} 14 & 6 & 20 \\ 6 & 8 & -3 \\ 20 & -1 & 18 \end{pmatrix}$ and B = $\begin{pmatrix} 9 & 4 & 5 \\ -8 & 16 & 7 \\ 13 & 2 & 12 \end{pmatrix}$ find B – A
11. If A = $\begin{pmatrix} 4 & -7 & 8 \\ -2 & 4 & 2 \\ 10 & 12 & -1 \end{pmatrix}$ find *det* A
12. Find the augmented matrix of the system 5x + 3y =9, 7x – 6y = 6

Part B

(Answer any 6 questions. Each carries 5 marks.)

13. Prove that $\sqrt{2}$ is irrational by giving a proof by contradiction.
14. Prove that $A\cap(B\cup C) = (A\cap B)\cup(A\cap C)$
15. Find the derivative dy/dx for each of the following implicit function
    a. $6x^2-7xy+2y^2 = 81$
    b. $5x^7+7x^2y+2y^2x = 81$
16. Given $y = (10x^8-6x^7)/2x$
    a. Find the derivative directly using the quotient rule
    b. Simplify the function by division and take its derivative
    c. Compare the two derivatives
17. Evaluate $\int_1^2 4xe^{x^2}dx$ by means of the substitution method
18. Use integration by parts to evaluate $\int 2xe^x dx$
19. If A = $\begin{pmatrix} 4 & 2 & 7 \\ 3 & 1 & 8 \\ 5 & 3 & 1 \end{pmatrix}$, find A^{-1}

20. If A = $\begin{pmatrix} 2 & 8 & 9 \\ 0 & 0 & 3 \end{pmatrix}$, find the dimension of the matrix also evaluate AA'

21. Solve using Cramer's Rule 5x + 4y =2, 7x –y = 4

PART C

(Answer any 2 questions. Each question has 15 marks.)

22. For the total cost function TC =Q^3-5Q^2+60Q find:

(a) the average cost AC function

(b) the critical value at which AC is minimized

(c) the minimum average cost.

Draw the graphs of the functions y=8-x^2 and y= -x +6 , and evaluate the area between the curves from x = -1 to x = 2

OR

23. (a) If y=$\frac{(4x^2-7)(6x+5)}{3x}$ find $\frac{dy}{dx}$

(b) If y= $(\frac{4x-5}{3x+1})^2$ find $\frac{dy}{dx}$

24. (a) Evaluate $\int \frac{x}{e^{x^2}}$

(b) Evaluate $\int_1^2 (x^3+5)^2 3x^2 dx$

OR

25. Solve using Cramer's rule 3x+3y-z=11, 2x-y+2z=9, 4x+3y+2z=25

B.A.(HONOURS) DEGREE PROGRAMME
SEMESTER II, CORE IV
ECH2COR08- MATHEMATICS IN ECONOMICS II (HONOURS)

. **6hours/week**

80 marks

Outcome/Objective

1. Understand the idea of multivariable functions and partial derivatives and properties.
2. Obtain Maxima and minima of two variable functions using partial derivatives.
3. Obtain Rank, Eigen values and eigen vectors of a matrix and properties.

Text Books:-

1. Taro Yamane , Mathematics for Economists

2. Edward T Dowing : Theory and Problems of Mathematical Methods for Business and Economics, Schaum's Outline Series ,McGraw Hill (1993)

Module I **30 hours**

Linear algebra-linear independence-rank of a matrix-Eigen values-eigen vectors, properties Diagonalization

(Sections :10.3,10.15,11.1,11.3,11.4 of text 1)

Module II **22 hours**

Functions with two or more variables- partial derivatives with two variables second and higher order partial derivatives, total derivative, implicit functions

(Sections: 4.1-4.7 of text 1)

Module III **21 hours**

Optimization –convex and concave functions-quasi convex and quasi concavity (concepts only) - unconstrained optimization-constrained optimization-Lagrange multiplier method-envelope theorem (idea only) (Sections 13.5-13.10 of text 2)

Module IV (**35 hours)**

Linear Differential equations with constant coefficients (first order and second order) applications-growth model-multiplier-accelerator interaction.

(Sections: 8.1-8.2,8.7-8.8 of text 1)

References

1. Chiang A Fundamental methods of mathematical economics, Mcgraw Hill
2. Henderson and Quandt, Micro economic theory: a mathematical approach
3. Simon and Blume, Mathematics for Econiomists:Viva –Norton student edition
4. Sydsaeter and Hammond, Mathematics for Economic Analysis, Pearson

BLUE PRINT
ECH2COR08- MATHEMATICS IN ECONOMICS II (HONOURS)

Module	Part A (2 marks)	Part B (5 marks)	Part C (15 marks)	Total
I	4	2	1	7
II	3	2	1	6
III	2	2	1	5
IV	3	3	1	7
Total No. of Questions	12	9	4	25
No. of questions to be answered	10	6	2	18
Total Marks	20	30	30	80

MAHARAJA'S COLLEGE (AUTONOMOUS) ERNAKULAM
MODEL QUESTION PAPER
ECONOMICS (HONS.) SECOND SEMESTER
ECH2COR08- Mathematics in Economics

Time: Three hours **Maximum:80 Marks**

Part A
(Answer 10 questions. Each carries 2 mark)

1. The vectors (1,2.-4) and (-2,4,8) are linearly independent. State true or false. Justify your answer?
2. Find the rank of the matrix $A = \begin{bmatrix} 1 & 3 \\ -1 & 4 \end{bmatrix}$.
3. Find the eigen values of the matrix $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$.
4. Give a 2×2 matrix whose eigen values are -3 and 5.
5. If u=xy, show that $x\frac{\partial u}{\partial x} = y\frac{\partial u}{\partial y}$
6. Express the function $z = \frac{-xy}{x+y}$ in implicit form.
7. Write the Fibonacci sequence and corresponding difference equation.
8. Find $\frac{\partial(2x-3y+1+xy)}{\partial y}$
9. Define marginal cost of labour and marginal cost of capital of a production function.
10. Define a strategic saddle point.
11. What is the order of the difference equation.
12. Define Quasi concave function.

(10X2=20)

Part C
(Answer any six questions. Each carries 5 marks.)

13. Solve the difference equation $y_{n+2} - 3y_{n+1} - 10y_n = 0$.
14. Find the rank of the matrix $A = \begin{bmatrix} 4 & 2 & 3 \\ 8 & 4 & 6 \\ -2 & -1 & -\frac{3}{2} \end{bmatrix}$.

15. Find the eigen values and eigen vectors of the matrix $A = \begin{bmatrix} 8 & -4 \\ 2 & 2 \end{bmatrix}$.

16. Solve the game $\begin{bmatrix} 3 & 5 & 4 & 9 & 6 \\ 5 & 6 & 3 & 7 & 8 \\ 8 & 7 & 9 & 8 & 7 \\ 4 & 2 & 8 & 5 & 3 \end{bmatrix}$ using dominance rule

17. Solve the $a_{n+2} - 6a_{n+1} + 5a_n = 2^n$ game $\begin{bmatrix} 5 & 1 \\ 3 & 4 \end{bmatrix}$ without saddle point.

18. Minimize the function $f = x^2 + y^2 + z^2$ subject to $g_1 = x + y + 3z - 2 = 0$ and $g_2 = 5x + 2y + z - 5 = 0$. Construct the hessian matrix.

19. Find the first order partial derivatives of $u = \log(x + y)$.

20. Solve the difference equation $2a_n - 3a_{n-1} = 0, n \geq 1, a_4 = 81$

21. If $u = x^2 - xy + 2y^2$, then prove that $x\frac{\partial u}{\partial x} + y\frac{\partial u}{\partial y} = 2u$.

(6X5=30)

Part C

(Answer any **Two** questions. Each question carries 1**5** marks)

22. Given $A = \begin{bmatrix} 4 & 1 \\ 2 & 3 \end{bmatrix}$

(i) Find eigen values and eigen vectors of A

(ii) Write the matrix P which diagonolize the matrix A

(iii) Diagonalize the matrix A.

OR

23.(i) Produce a matrix P, if exists, that diagonalize the given matrix $A = \begin{bmatrix} 5 & 0 & 0 \\ 1 & 0 & 3 \\ 0 & 0 & -2 \end{bmatrix}$

(ii) Minimize the function $f = x^2 + y^2$ subject to $3x^2 + 6y^2 + 4xy = 140$.

24 .(i) Explain minimax criterian in a game

(ii) Explain arithmetic method for 2×2 game.

(iii) Solve the game with the following payoff matrix

$$\begin{array}{cccc} & I & II & III \\ I & 1 & 7 & 8 \\ II & 6 & 2 & 7 \\ III & 5 & 2 & 6 \end{array}$$

OR

25. (i) Find the minimum or maximum of function $f = x^2 + y^2$ subject to x+y=1

(ii)Solve the difference equation $a_{n+2} - 6a_{n+1} + 5a_n = 2^n$

(15X2=30)

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