1. NAME OF THE PROGRAMME: B. Sc. - Mathematics (Hons) (R 23)

2. ELIGIBILITY

The qualification descriptor suggests the generic outcomes and attributes to be obtained while obtaining the degree of B.Sc. (Hons) Mathematics or B.Sc. with Mathematics as a subject. The qualification descriptors indicate the academic standards on the basis of following factors:

i. Level of knowledge

ii. Understanding

iii. Skills

iv. Competencies and attitudes

v. Values.

The eligibility criterion for a Bachelor of Science (B.Sc.) in Mathematics course is to pass Class 12 from a recognized board with a minimum aggregate of 55% in the Science stream.

Relaxation: Students from SC/ST communities may be eligible for a 5% relaxation.

Note: Candidates who have passed Intermediate (Vocational) Courses from the Board of Intermediate Education, AP OR +2 Examination conducted by any other Board the candidates shall **submit an equivalence certificate** issued by the Board of Intermediate Education, Andhra Pradesh.

3. ABOUT DEPARTMENT

3.1 History

As a matter of pride, the department of Mathematics was established by two eminent Mathematicians Sri Satyanarayana and Sri Vanga Madhava Rao in the year 1881. The department started offering graduation courses with Astronomy and Solid Geometry. It has the distinction as the first Science group introduced in the College. Since its inception, it has been working in tune with the mission of MR College to promote teaching, research and extension activities.

The department was enriched with loving blessings of the stalwarts of yester year Sri Karri Subba Rao, Sri Sonti Purushotham, Sri P. Somanadham, Sri M. Perisastry, Sri G. V.R Subramanyam and many more who enabled the department to attain its distinction and uniqueness. Some of the alumni of this department have served in leading positions of various organizations such as RBI, ISRO, Indian Statistical Institute, Planning Commission of India.

Apart from the academic services, the department is striving to support the student learning through co-curricular activities, E-learning, ICT, Seminars, Guest lectures, Workshop etc. The department is well equipped and facilities for advanced learning and skill enhancement in order to have a good track of placements in the diverse fields like Defiance services, Banking, Revenue, Software, Parma and many more government and public sectors.

3.2 Vision and Mission

Vision

The Department of mathematics will guide students to grow to skills to solve problems in a more logical and methodical way. It will facilitate students with analytical and scientific knowledge to contribute to the progression of the society. It will provide fundamental education through promoting research in diverse and interdisciplinary areas.

Mission

- To encourage the students to conduct projects to develop their analytical and logical thinking.
- To make the students proficient in Mathematics, this makes them to be successful in their further studies and careers. To make a department global.
- To achieve high standards of excellence in generating and propagating knowledge in Mathematics. Department is committed to providing an education that combines rigorous academics with joy of discovery.
- To provide an environment where students can learn, become competent users of mathematics, and understand the use of mathematics in other drip lines.
- The syllabus offered by the department with respect to semester system under CBCS at UG level is aimed to providing the students with a strong foundation of the subject and making them proficient in all aspects both theory and project so that they are ready to take up higher studies in Mathematics in any reputed institution in the world.
- We are proud in making students to pursue higher studies in various Universities by organizing PGCET coaching since 2014.

4. ABOUT THE PROGRAMME

4.1 About the Course

A Bachelor of Science (B.Sc.) in Mathematics is an undergraduate degree program that typically takes three years (four years for Hons) to complete. The program covers a variety of mathematical topics, including: Calculus, Algebra, Geometry, Statistics, Trigonometry, Analytical geometry, and Computer languages. The program helps students develop analytical, logical, and interpretive skills, as well as the ability to solve problems using critical observation. These skills are valuable in many fields, including engineering, finance, natural science, and social science. Mathematics is the study and investigation of structure, quantity, and space. The program is designed to construct basic mathematical aptitude for crafting researchers and scientists of tomorrow for addressing the needs of the next century. They can also pursue masters program in Mathematics after graduation.

4.2 Programme Nature, Extent and Aims

"Mathematics is the subject which provides an opportunity for the training of mind to close thinking, stirring up a sleeping and unstructured spirit". – ***Plato***

Mathematics is concerned with numerical facts and relationships. Mathematics is concerned with problems that involve space and shape. Mathematics establishes many links between spatial phenomena. Mathematics enables man to comprehend his ideas and conclusions precisely.

Mathematics relies on both logic and creativity, and it is pursued both for a variety of practical purposes and for its intrinsic interest. For some people, and not only professional mathematicians, the essence of mathematics lies in its beauty and its intellectual challenge. For others, including many scientists and engineers, the chief value of mathematics is how it applies to their own work. Because mathematics plays such a central role in modern culture, some basic understanding of the nature of mathematics is requisite for scientific literacy. To achieve this, students need to perceive mathematics as part of the scientific endeavor, comprehend the nature of mathematical thinking, and become familiar with key mathematical ideas and skills.

Mathematics is the study of quantity, structure, space and change. It has very broad scope in science, engineering and social sciences. The key areas of study in mathematics are:

1. Calculus

2. Algebra

3. Geometry

4. Differential Equations

5. Analysis

6. Mechanics

Degree programs in mathematics cover topics which are already mentioned in details under various headings in Section 6. The depth and breadth of study of individual topics depend on the nature and devotion of learners in specific mathematics programmes.

As a part of effort to enhance employability of mathematics graduates, the courses have been designed to include learning experiences, which offer them opportunities in various sectors of human activities. In this context, the experience of the project work in the areas of applications of mathematics has a key role.

THE AIMS OF THE PROGRAMME INCLUDE

- **Developing analytical and critical reasoning skills**

  Students should be able to present logical arguments and solve problems.

- **Building a foundation for higher studies**

  Students should gain a thorough knowledge of core topics and be able to apply them to other areas, such as computer science or physical science.

- **Learning to work in teams**

  Students should be able to work effectively with others to achieve a common goal.

- **Communicating effectively**

  Students should be able to communicate mathematical ideas and concepts clearly and coherently. Encourage the students to develop a range of generic skills helpful in employment, internships and social activities.

- **Applying mathematics to real-world problems**

  Provide students/learners sufficient knowledge and skills enabling them to undertake further studies in mathematics and its allied areas on multiple disciplines concerned with mathematics. Students should be able to apply mathematical techniques and algorithmic principles to model and design computer systems and software.

- **Preparing for competitive exams**

  Students should gain the knowledge and skills needed to prepare for competitive exams.

4.3. GRADUATE ATTRIBUTES (GAs)

The Graduate Attributes (GAs) reflect particular qualities and abilities of an individual learner including Knowledge, application of knowledge, professional and life skills, attitudes and human values those are required to be acquired by the graduates of Maharajah’s College. The graduate attributes include capabilities to strengthen one’s professional abilities for widening current knowledge and industry-ready skills, undertaking Future studies for global and local application, performing creatively and professionally, in a chosen career and ultimately playing a constructive role as a socially responsible global citizen. The Graduate Attributes define the Characteristics of learners and describe a set of competencies that are beyond the study of a particular area and programme.

The GAs

- Disciplinary knowledge
- Communications skills
- Critical thinking and analytical reasoning
- Problem solving:
- Research-related skills
- Information/digital literacy
- Self-directed learning
- Moral and ethical awareness/reasoning
- Lifelong learning

5. PROGRAMME OUTCOMES (POs)

The overall aims of the programme may be achieved by addressing its various components that are incorporated into the curriculum as described below. Each of these components is designed to lead to specific outcomes that are desired after the successful completion of the programme.

PO No.	component	outcomes
PO1	Disciplinary Knowledge	Capable of demonstrating comprehensive knowledge and understanding of one or more other disciplines that form a part of an undergraduate programme of study.
PO2	Critical Thinking and problem solving	Take informed actions after identifying the assumptions that frame our thinking and actions, checking out the degree to which these assumptions are accurate and valid, and looking at our ideas and decisions (intellectual, organizational, and personal) from different perspectives. Critically evaluate practices, policies and theories by following scientific approach to knowledge development.
PO3	Communication Skills	Ability to express thoughts and ideas effectively in writing and orally; communicate with others using appropriate media; confidently share one's views and express herself/ himself; demonstrate the ability to listen carefully; and present complex information in a clear and concise manner to different groups.
PO4	Analytical thinking	Analytical skills are the skills you use to make decisions and find solutions to problems. In the workplace, an analytical person helps the company problem-solve by breaking down information; looking through data and finding patterns, trends, and outliers; brainstorming new ideas; and making decisions on what solutions to implement.
PO5	Professional skills	Understand, analyze and communicate the value of their professional roles in society.
PO6	Moral and Ethical Awareness	Ability to embrace moral/ ethical values in conducting one's life, possess knowledge of the values and beliefs of multiple cultures and a global perspective; and capability to effectively engage in a multicultural society and interact respectfully with diverse groups.
PO7	Application skills and experimental skill	Application skills and experimental skills are a broad set of skills that are used in scientific experiments, including: Planning, Experimental design, Data analysis, Communication, Safety, and Equipment use, Troubleshooting, Literature review, Evidence-based argumentation.
PO8	Self-directed and Life-long Learning	Acquire the ability to engage in independent and life- long learning in the broadest context socio- technological changes. Critical sensibility to lived experiences, with self-awareness and reflexivity of both and society.
PO9	Information and Digital Literacy	Capability to use ICT in a variety of learning situations. Demonstrate ability to access, evaluate and use a variety of relevant information sources; and use appropriate software for analysis of data.
PO10	Research–related skills	A sense of inquiry and capability for asking relevant/ appropriate questions, problematizing, synthesizing and articulating; Ability to recognize cause- and- effect relationships, define problems, formulate hypotheses, interpret and draw conclusions from data, ability to plan, execute and report the results of an experiment or investigation. Ability to apply one's learning to real life situations.

6. PROGRAMME SPECIFIC OUTCOMES (PSOs)

The B.Sc. mathematics graduates shall be able to realize the following specific outcomes by the end of program studies:

PSO NO.	Component	Programme specific outcome
PSO1	Solid Foundation in Knowledge	Bachelor Degree in Mathematics is the culmination of in-depth knowledge of many core branches of mathematics, viz. Algebra, Calculus, Geometry, Differential Equations, Mechanics, Real and Complex Analysis including some related areas like Computer Science and Statistics. Thus, this programme helps students in building a solid foundation for further higher studies and research in Mathematics.
PSO2	Competency in Skill	The skills and knowledge gained has intrinsic beauty, which leads to proficiency in analytical reasoning, critical understanding, analysis and synthesis in order to solve theoretical and practical problems. This can orient students towards applications of mathematics in other disciplines and moreover, can also be utilized in modeling and solving real life problems
PSO3	Problem Solving	Students undergoing this programme learn to logically question assertions, to recognize patterns and to distinguish between essential and irrelevant aspects of problems. This helps them to learn behave responsibly in a rapidly changing interdependent society
PSO4	Interdisciplinary and Research Skills	Students completing this programme will be able to present mathematics clearly and precisely, make vague ideas precise by formulating them in the language of mathematics, describe mathematical ideas from multiple perspectives and explain fundamental concepts of mathematics to non-mathematicians.
PSO5	Proficiency in Employments	This programme will help students to enhance their employability for Government jobs, jobs in banking, insurance and investment sectors, data analysis jobs, and jobs in various other public and private enterprises.

7. MAPPING OF PROGRAMME OUTCOMES WITH PROGRAMME SPECIFIC OUTCOMES

Sl.No.	PSO → / PO ↓	PSO1	PSO2	PSO3	PSO4	PSO5
1	PO1	✔	✔	✔	✔	✔
2	PO2	✔	✔	✔	✔	✔
3	PO3		✔		✔	✔
4	PO4	✔	✔	✔	✔	✔
5	PO5		✔	✔	✔	✔
6	PO6				✔	✔
7	PO7	✔	✔	✔	✔	✔
8	PO8	✔	✔	✔	✔	✔
9	PO9	✔	✔	✔	✔	✔
10	PO10	✔	✔	✔	✔	✔

8. MAPPING OF COURSE WITH PROGRAMME SPECIFIC OUTCOMES

Sl. No.	YEAR	Semester	Name of the course	PSO1	PSO2	PSO3	PSO4	PSO5
1	I	I	Analytical Skills **(SEC)**	✔	✔	✔	✔	✔
2		II	Differential Equations & Problem Solving Sessions	✔	✔	✔	✔	✔
3			Analytical Solid Geometry & Problem Solving Sessions	✔	✔	✔	✔	✔
4			Differential Equations & Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔
5			**Community Service Program**					
6	II	III	Group Theory &Problem Solving Sessions	✔	✔	✔	✔	✔
7			Numerical Methods & Problem Solving Sessions	✔	✔	✔	✔	✔
8			Laplace Transforms & Problem Solving Sessions	✔	✔	✔	✔	✔
9			Special Functions & Problem Solving Sessions	✔	✔	✔	✔	✔
10			Group Theory &Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔
11		IV	Ring Theory & Problem Solving Sessions	✔	✔	✔	✔	✔
12			Introduction to Real Analysis & Problem Solving Sessions	✔	✔	✔	✔	✔
13			Integral Transforms & Problem Solving Sessions	✔	✔	✔	✔	✔
14			Ring Theory & Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔
15			Introduction to Real Analysis & Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔

16			**Short term Internship**					
17	**III**	**V**	Linear Algebra & Problem Solving Sessions	✔	✔	✔	✔	✔
18			Vector Calculus & Problem Solving Sessions	✔	✔	✔	✔	✔
19			Advanced Numerical Methods & Problem Solving Sessions	✔	✔	✔	✔	✔
20			Number Theory & Problem Solving Sessions	✔	✔	✔	✔	✔
21			Linear Algebra & Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔
22			Vector Calculus & Problem Solving Sessions **(MINOR)**	✔	✔	✔	✔	✔
23		**VI**	**Long Term Internship**					
24	**IV**	**VII**	Algebra	✔	✔	✔	✔	✔
25			Real Analysis	✔	✔	✔	✔	✔
26			Basic Topology	✔	✔	✔	✔	✔
27			Lattice Theory & Boolean Algebra	✔	✔	✔	✔	✔
28			Graph Theory	✔	✔	✔	✔	✔
29		**VIII**	Advanced Algebra	✔	✔	✔	✔	✔
30			Advanced Linear Algebra	✔	✔	✔	✔	✔
31			Advanced Topology	✔	✔	✔	✔	✔
32			Ordinary Differential Equations	✔	✔	✔	✔	✔
33			Operation Research	✔	✔	✔	✔	✔

9. STRUCTURE OF THE PROGRAMME (INSTRUCTION & EXAMINATION)

SEMESTER-I

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	Essentials and Applications of Mathematical, Physical and Chemical Sciences	R23FNDT111	Theory	5	60	40	100	4
2	Advances in Mathematical, Physical and Chemical Sciences	R23FNDT112	Theory	5	60	40	100	4
3	**Analytical Skills (SEC)**	**R23MATT151**	**Theory**	**2**	**30**	**20**	**50**	**2**
4	Communication Skills (SEC)	R23ENGT151	Theory	2	30	20	50	2
5	Principles of Psychology (MDC)	R23PSYT141	Theory	2	30	20	50	2
6	English (CSS)	R23ENGT131	Theory	4	60	40	100	4
7	Sahithi Sowrabham /sansrukutha chandramaha-I	R23TELT131 R23SKTT131	Theory	4	60	40	100	4

SEMESTER-II

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	**Differential Equations & Problem Solving Sessions**	**R23MATT211**	**Theory**	**5**	**60**	**40**	**100**	**4**
2	**Analytical Solid Geometry & Problem Solving Sessions**	**R23MATT212**	**Theory**	**5**	**60**	**40**	**100**	**4**
3	English(Reading & writing Skills)	R23ENGT231	Theory	4	60	40	100	4
4	Telugu / sansrukutha chandramaha-II	R23TELT231 R23SKTT231	Theory	4	60	40	100	4
5	Business Writing	R23ENGT251	Theory	2	30	20	50	2
6	Digital Literacy	R23CSCT251	Theory	2	30	20	50	2
7	**MINOR-01. Differential Equations & Problem Solving Sessions**	**R23MATT221**	**Theory**	**5**	**60**	**40**	**100**	**4**
I	Community service project (180Hrs)							4

SEMESTER-III

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	**Group Theory &Problem Solving Sessions**	**R23MATT311**	**Theory**	**5**	**60**	**40**	**100**	**4**
2	**Numerical Methods & Problem Solving Sessions**	**R23MATT312**	**Theory**	**5**	**60**	**40**	**100**	**4**
3	**Laplace Transforms & Problem**	**R23MATT313**	**Theory**	**5**	**60**	**40**	**100**	**4**
4	**Special Functions & Problem Solving Sessions**	**R23MATT314**	**Theory**	**5**	**60**	**40**	**100**	**4**
5	Information and Communication Technology	R23CSCT351	Theory	2	30	20	50	2
6	Introduction to Public Administration	R23POLT351	Theory	2	30	20	50	2
7	**MINOR-02. Group Theory &Problem Solving Sessions**	**R23MATT321**	**Theory**	**5**	**60**	**40**	**100**	**4**

SEMESTER-IV

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	**Ring Theory & Problem Solving Sessions**	**R23MATT411**	**Theory**	**5**	**60**	**40**	**100**	**4**
2	**Introduction to Real Analysis & Problem Solving Sessions**	**R23MATT412**	**Theory**	**5**	**60**	**40**	**100**	**4**
3	**Integral Transforms & Problem Solving Sessions**	**R23MATT413**	**Theory**	**5**	**60**	**40**	**100**	**4**
4	Indian Philosophy	R23PHIT441	Theory	2	0	20	50	2
5	Cyber security	R23CSCT451	Theory	2	0	20	50	2
6	**MINOR-03. Ring Theory & Problem Solving Sessions**	**R23MATT421**	**Theory**	**5**	**60**	**40**	**100**	**4**
7	**MINOR-4. Introduction to Real Analysis & Problem Solving Sessions**	**R23MATT422**	**Theory**	**5**	**60**	**40**	**100**	**4**
II	Short term Internship (180Hrs)							4

SEMESTER-V

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	Linear Algebra & Problem Solving Sessions	R23MATT511	Theory	5	60	40	100	4
2	Vector Calculus & Problem Solving Sessions	R23MATT512	Theory	5	60	40	100	4
3	Advanced Numerical Methods & Problem Solving Sessions	R23MATT513	Theory	5	60	40	100	4
4	Number Theory & Problem Solving Sessions	R23MATT514	Theory	5	60	40	100	4
5	**Environmental Education**	**R23CHET571**	**Theory**	**2**	**30**	**20**	**50**	**2**
6	MINOR-5.Linear Algebra & Problem Solving Sessions	R23MATT521	Theory	5	60	40	100	4
7	MINOR-6.Vector Calculus & Problem Solving Sessions	R23MATT522	Theory	5	60	40	100	4

SEMESTER-VI

III	Long term Semester Internship (16 weeks)	12

SEMESTER-VII

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	Algebra	R23MATT711	**Theory**	5	60	40	100	4
2	Discrete Mathematics	R23MATT712	**Theory**	5	60	40	100	4
3	Basic Topology	R23MATT713	**Theory**	5	60	40	100	4
4	Lattice Theory & Boolean Algebra	R23MATT714	**Theory**	5	60	40	100	4
5	Graph Theory	R23MATT715	**Theory**	5	60	40	100	4

SEMESTER-VIII

S. No.	Paper Title	Course code	Course type	Instruction periods per week	External Marks	Internal Marks	Total Marks	Credits
1	Advanced Algebra	R23MATT811	**Theory**	5	60	40	100	4
2	Advanced Linear Algebra	R23MATT812	**Theory**	5	60	40	100	4
3	Advanced Topology	R23MATT813						
SEC								
4	Ordinary Differential Equations	R23MATT814	**Theory**	5	60	40	100	4
5	Operation Research	R23MATT815	**Theory**	5	60	40	100	4

10. DETAILED COURSES

SEMSTER –I

I. Analytical Skills (SEC)

COURSE OUTCOMES:

After successful completion of this course, the student will be able to;

CO1. Understand the basic concepts of arithmetic ability, quantitative ability, logical reasoning, business computations and data interpretation and obtain the associated skills.

CO2. Acquire competency in the use of verbal reasoning.

CO3. Apply the skills and competencies acquired in the related areas

CO4. Solve problems pertaining to quantitative ability, logical reasoning and verbal ability inside and outside the campus.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 0	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔			✔	✔	✔	✔	✔	✔	✔	✔	✔
CO03	✔	✔	✔	✔	✔	✔	✔	✔		✔	✔		✔		
CO04	✔	✔		✔			✔	✔			✔		✔		

Course Content

UNIT – 1:

Arithmetic ability: Algebraic operations BODMAS, Fractions, Divisibility rules, LCM & GCD (HCF).

Verbal Reasoning: Number Series, Coding & Decoding, Blood relationship, Clocks, Calendars.

UNIT – 2:

Quantitative aptitude: Averages, Ratio and proportion, Problems on ages, Time-distance – speed.

Business computations: Percentages, Profit & loss, Partnership, simple compound interest.

UNIT – 3:

Data Interpretation: Tabulation, Bar Graphs, Pie Charts, line Graphs. Venn diagrams.

Recommended Co-Curricular Activities

Surprise tests / Viva-Voice / Problem solving/Group discussion.

Text Book: Quantitative Aptitude for Competitive Examination by R.S. Agrawal, S.Chand Publications.

Websourses: https://www.youtube.com/watch?v=kyCfVNGYL4c

Reference Books

1. Analytical skills by Showick Thorpe, published by S Chand And Company Limited, Ramnagar,New Delhi-110055

2. Quantitative Aptitude and Reasoning by R V Praveen, PHI publishers.

3. Quantitative Aptitude for Competitive Examination by Abhijit Guha, Tata Mc Graw HillPublications.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course I . Analytical Skills				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Arithmetic Ability and Verbal Reasoning	2	2	20
II	Quantitative Aptitude and Business Computation	2	2	20
III	Data Interpretation	1	2	18
TOTAL		**5**	**6**	**58**
S.A.Q. = SHORT ANSWER QUESTIONS		**3*2= 06 MARKS**		
E.Q. = ESSAY QUESTIONS		**3*8= 24 MARKS**		
TOTAL MARKS		**30 MARKS**		

I B. Sc; First Semester Examinations Model Paper

ANALYTICAL SKILLS

Time: 1 ½ hrs Max.Marks:30M

SECTION-A

I. Answer any THREE from the following 3x2=6M

1. The H.C.F of two numbers is 11 and their L.C.M is 7700.If one of the number is 275, then Find the other number?
2. If $\frac{2x}{1+\frac{1}{1+\frac{x}{1-x}}}=1$, then find the value of x?
3. A, B,C enter into a partnership investing Rs. 35000,45000 and 55,000 respectively. Find the respective shares of A,B,C in an annual profit of Rs. 40,500 ?
4. At what rate percent per annum will a sum of money double in 16 years?
5. How to find the central angle of the component?

SECTION-B

II. Answer all the following questions. Each question carries EIGHT marks. 3x8=24M

6 (a). Explain any four Divisibility Rules with relevant Examples.

(OR)

6(b). i) What was the day of week on 4^{th} June,2002?

ii) Find at what time between 8 and 9 o'clock will the hands of a clock be in the same straight line but not together?

7(a). i) The present age of a father is 3 years more than three times the age of his son. Three years hence, father's age will be 10 years more than twice the age of the son,. Find the present age of the father?

ii) A cyclist covers a distance of 750m in 2 min 30 sec. What is the speed in km/hr of the cyclist?

(OR)

7(b) . A salesman's commission is 5% on all sales up to Rs. 10,000 and 4% on all sales exceeding this. He remits Rs. 31,100 to his parent company after deducting his commission. Find the total sales.

8(a) . Study the following table carefully and answer these questions:

NUMBER OF CANDIDATES APPEARED AND QUALIFIED IN A COMPETITIVE EXAMINATION FROM DIFFERENT STATES OVER THE YEARS

Year / State	1997		1998		1999		2000		2001	
	App.	Qual.	App.	Qual.	App.	Qual.	App.	Qual.	App.	Qual.
M	5200	720	8500	980	7400	850	6800	775	9500	1125
N	7500	840	9200	1050	8450	920	9200	980	8800	1020
P	6400	780	8800	1020	7800	890	8750	1010	9750	1250
Q	8100	950	9500	1240	8700	980	9700	1200	8950	995
R	7800	870	7600	940	9800	1350	7600	945	7990	885

1. Combining the states P and Q together in 1998, what is the percentage of the candidates qualified to that of the candidates appeared?
   (a) 10.87% (b) 11.49% (c) 12.35% (d)12.54%
2. The percentage of the total number of qualified candidates to the total number of appeared candidates among all the five states in 1999 is
   (a) 11.49% (b)11.84% (c) 12.21% (d) 12.57%
3. What is the percentage of candidates qualified from State N for all the years together, over the candidates appeared from State N during all the years together?
   (a) 12.36% (b) 12.16% (c) 11.47% (d) 11.15%
4. What is the average of candidates who appeared from State Q during the given years?
   (a) 8990 (b) 8760 (c) 8810 (d) 8920

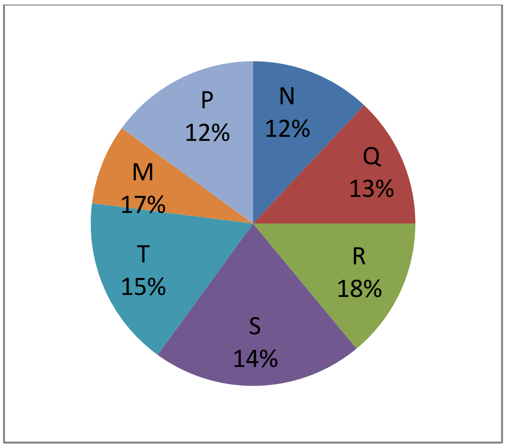
(OR)

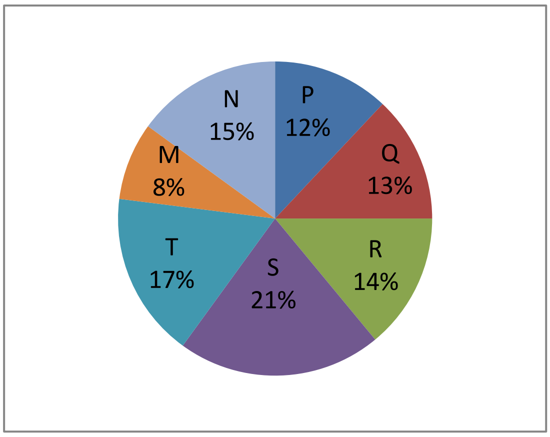
8(b). The following pie-charts show the distribution of students of graduate and post graduate levels in seven different institutes –M,N,P,Q,R,S and T in a town

DISTRIBUTION OF STUDENTS AT GRADUATE AND POST-GRADIATE LEVELS IN SEVEN INSTITUTIONS –M,N,P,Q,R,S and T

Total Number of Students of Graduate Level =27300

Total Number of Students of Post-Graduate Level = 24700





1. How many students of institutes M and S are studying at graduate level?

(a) 7516 (b)8463 (c) 9127 (d) 9404

2. Total number of students studying at post-graduate level from institutes N and P is :

(a)5601 (b)5944 (c) 6669 (d) 7004

3. What is the total number of graduate and post – graduate level students in institute R?

(a) 8320 (b)7916 (c)9116 (d) 8372

4. What is the ratio between the number of students studying at post-graduate and graduate levels respectively from institute S?

(a) 14:19 (b) 19:21 (c) 17:21 (d) 19:14

SEMESTER –II

1. Differential Equations (MAJOR)

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Solve first order first degree linear differential equations.

CO2. Convert a non-exact homogeneous equation to exact differential equation by using an integrating factor.

CO3. Know the methods of finding solution of a differential equation of first order but not of first degree.

CO4. Solve higher-order linear differential equations for both homogeneous and non-homogeneous, with constant coefficients.

CO5. Understand and apply the appropriate methods for solving higher order differential equations.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

Differential Equations of first order and first degree

Linear Differential Equations – Bernoulli's Equations - Exact Differential Equations –Integrating factors - Equations reducible to Exact Equations by Integrating Factors - i) Inspection Method ii) $\frac{1}{Mx+Ny}$ iii) $\frac{1}{Mx-Ny}$

Unit – 2

Differential Equations of first order but not of first degree

Equations solvable for p, Equations solvable for y, Equations solvable for x – Clairaut's equation - Orthogonal Trajectories: Cartesian and Polar forms.

Unit – 3

Higher order linear differential equations

Solutions of homogeneous linear differential equations of order n with constant coefficients - Solutions of non-homogeneous linear differential equations with constant coefficients by means of polynomial operators

(i) $Q(x) = e^x$ (ii) $Q(x)$ = $Sin\ ax$ (or) $Cos\ ax$ ax

Unit – 4

Higher order linear differential equations (continued.)

Solution to a non-homogeneous linear differential equation with constant coefficients

P.I. of (D) = Q when Q = bx^k

P.I. of (D) = Q when Q = $e^{ax}V$, where V is a function of x

P.I. of (D) = Q when Q = xV, where V is a function of x

Unit – 5

Higher order linear differential equations with non-constant coefficients

Linear differential Equations with non-constant coefficients; Cauchy-Euler Equation; Legendre Equation; Method of variation of parameters.

Activities

Seminar/ Quiz/ Assignments/ Applications of Differential Equations to Real life Problem /Problem Solving Sessions.

Text Book

Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Ordinary and Partial Differential Equations by Dr. M.D. Raisinghania, published by S. Chand &Company, New Delhi.
2. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- Universities Press.
3. Differential Equations -Srinivas Vangala &Madhu Rajesh, published by Spectrum University Press.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 3. Differential Equations				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Differential Equations of first order and first degree	2	2	24
II	Differential Equations of first order but not of first degree	2	2	24
III	Higher order linear differential equations	1	2	22
IV	Higher order linear differential equations (continued.)	2	2	24
V	Higher order linear differential equations with non-constant coefficients	1	2	22
TOTAL		**8**	**10**	**116**
S.A.Q. = SHORT ANSWER QUESTIONS		**5*2= 10 MARKS**		
E.Q. = ESSAY QUESTIONS		**5*10= 50 MARKS**		
TOTAL MARKS		**60 MARKS**		

1^{st} B.Sc., SECOND SEMESTER MATHEMATICS MODEL PAPER

DIFFERENTIAL EQUATIONS

PART-A

Answer any FIVE questions from the following **5x2 =10M**

1. Solve $(e^y+1)\cos x\,dx + e^y \sin x\,dy = 0$
2. Solve $(y - xy^2)\,dx - (x + x^2y)\,dy = 0$
3. Solve $x + yp^2 = (1+ xy)p$
4. Solve $(y - xp)(p - 1) = p$
5. Solve $(D^4 - 4D^3 + 6D^2 - 4D + 1)y = 0$
6. Find the particular values of $\frac{1}{(D-2)(D-3)}\ e^{2x}$
7. Find the complementary functions of $(D^4 + 2D^2 + 1)\,y = x^2 \cos x$
8. Find the complementary function of $(x^2D^2 + 2xD - 12)\,y = x^3 \log x$

PART – B

Answer any FIVE questions from the following **5x10 = 50M**

9. a) Solve $y^2\,dx + (x^2 - xy - y^2)\,dy = 0$

(OR)

b) Solve $x\frac{dy}{dx} + y = y^2 \log x$

10.a) Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{a^2+\lambda} = 1$, where λ is the parameter

(OR)

b) Solve $y + px = p^2 x^4$

11. a) Solve $(D^3 - 5D^2 + 7D - 3)\,y = e^{2x} \cosh x$

(OR)

b)Solve $(D^2 - 4D + 3)\,y = \sin 3x \cos 2x$

12.a) Solve $(D^4 + D^2)\,y = 3x^2 + 4\sin x - 2\cos x$

(OR)

b)Solve $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = xe^x \sin x$

13. a) Solve $(D^2 - 2D + 2)\,y = e^x \tan x$ by the method of variation of parameters

(OR)

b) Solve $[(1+ 2x^2)^2 D^2 - 6(1+ 2x)D + 16]\,y = 8(1+2x)^2$

2. ANALYTICAL SOLID GEOMETRY (MAJOR)

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand planes and system of planes

CO2. Know the detailed idea of lines

CO3. Understand spheres and their properties

CO4. Know system of spheres and coaxial system of spheres

CO5. Understand various types of cones

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

The Plane

Equation of plane in terms of its intercepts on the axis - Equations of the plane through the given points - Length of the perpendicular from a given point to a given plane - Bisectors of angles between two planes - Combined equation of two planes - Orthogonal projection on a plane.

Unit – 2

The Line

Equation of a line - Angle between a line and a plane - The condition that a given line may lie in a given plane - The condition that two given lines are coplanar - Number of arbitrary constants in the equations of straight line - Sets of conditions which determine a line - The shortest distance between two lines - The length and equations of the line of shortest distance between two straight lines - Length of the perpendicular from a given point to a given line.

Unit – 3

The Sphere

Definition and equation of the sphere - Equation of the sphere through four given points - Plane sections of a sphere - Intersection of two spheres - Equation of a circle - Sphere through a given circle - Intersection of a sphere and a line - Power of a point - Tangent plane - Plane of contact; Polar plane - Pole of a Plane - Conjugate points - Conjugate planes.

Unit – 4

Spheres (continued)

Angle of intersection of two spheres - Conditions for two spheres to be orthogonal - Radical plane; Coaxial system of spheres - Simplified from of the equation of two spheres.

Unit – 5

Cones

Definitions of a cone – vertex, guiding curve and generators - Equation of the cone with a given vertex and guiding curve - Equations of cones with vertex at origin are homogenous - Condition that the general equation of the second degree should represent a cone - Enveloping cone of a sphere - Right circular cone - Equation of the right circular cone with a given vertex, axis and semi vertical angle.

Activities
Seminar/ Quiz/ Assignments/Three dimensional analytical Solid geometry and its applications/ Problem Solving Sessions.

Text Book
Analytical Solid Geometry by Shanti Narayan and P.K. Mittal, published by S. Chand & Company Ltd. 7th Edition.

Web Sources: https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. A text Book of Analytical Geometry of Three Dimensions, by P.K. Jain and Khaleel Ahmed, published by Wiley Eastern Ltd., 1999.
2. Co-ordinate Geometry of two and three dimensions by P. Balasubrahmanyam, K.Y. Subrahmanyam, G.R. Venkataraman published by TataMcGraw -Hill Publishers.
3. Solid Geometry by B. Rama Bhupal Reddy, published by Spectrum University Press.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 4. ANALYTICAL SOLID GEOMETRY				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	The Plane	2	2	24
II	The Line	2	2	24
III	The Sphere	1	2	22
IV	Spheres (Continued)	2	2	24
V	Cones	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Paper-4 ANALYTICAL SOLID GEOMETRY MODEL PAPER

PART-A

Answer any FIVE questions from the following **5x2=10M**

1. Find the equation of the plane through the point (-1,3,2) and perpendicular to each of theplanes x+2y+2z-5=0 and 3x+3y+2z-8=0.

2. Find the equation of the plane passing through (2,-3,1) and whose normal is the line joiningthe points (3,4,-1) and (2,-1,5).

3. Find the point of intersection of the line $\frac{x+1}{1}=\frac{y+3}{3}=\frac{z+2}{-2}$ with the plane $3x+4y+5z-5=0$.

4. Show that the line $\frac{x-2}{1}=\frac{y-2}{2}=\frac{z+1}{3}$ lies in the plane $5x+2y-3z-17=0$.

5. Find the equation of the sphere through the circle $9x^2+y+z^2=$, 2x+3y+4z=5 and the point (1, 2, 3).

6. Find the pole of the plane x-y+5z-3=0 with respect to the sphere $x^2+y^2+z^2=9$.

7. Show that the spheres $x^2 + y^2 + z^2 + 6y + 2z + 8 = 0, x^2 + y + z^2 + 6x + 4z + 20 = 0$ are Orthogonal.

8. Find the Enveloping cone of the sphere $x^2 + y^2 + z^2 + 2x - 2y - 2 = 0$ with its vertex at (1,1,1).

PART-B

Answer any FIVE questions from the following **5x10=50M**

9. a) Find the bisecting plane of acute angle between the planes

3x-6y +2z+5=0, 4x-12y+3z-3=0. Also find the plane bisecting the angle containing the origin.

(OR)

b) Show that the equation $2x^2 - 3y^2 + 4z^2 + xy + 6zx - yz = 0$ represents a pair of planes. Also find the angle between them.

10. a) Show that the lines $\frac{x+1}{1}=\frac{y+1}{2} = \frac{z+1}{3}$ and $x+2y+3z-8=0=2x+3y+4z-11$ are intersecting. Find the point of their intersection and the equation to the plane containing them.

(OR)

b) Find the shortest distance and the equations line of shortest distance between the lines

$\frac{x-3}{3}=\frac{y-8}{-1} = \frac{z-3}{1}$, $\frac{x+3}{-3}=\frac{y+7}{2} = \frac{z-6}{4}$

11a)Find the equations of the spheres which pass through the circle $x^2 + y^2 + z^2 = 5$,$x+2y+3z-3=0$, and touch the plane $4x+3y=15$.

(OR)

b) Show that the spheres $x^2 + y^2 + z^2 = 64$,$x^2 + y^2 + z^2 - 12x + 4y - 6z + 48 = 0$

touch internally. Find the point of contact.

12. a) Find the equation of the sphere which touches the plane 3x+2y-z+2=0 at (1,-2,1) and cuts orthogonally the sphere $x^2 + y^2 + z^2 - 4x + 6y + 4 = 0$

(OR)

b) Find the limiting points of the coaxal system of spheres 0determined by the spheres

$x^2 + y^2 + z^2 + 4x - 2y + 2z + 6 = 0$,$x^2 + y^2 + z^2 + 2x - 4y - 2z + 6 = 0$.

13. a) Find the equation of the cone whose vertex is (1,1,0) and guiding curve

$x^2+z^2 =4$, y =0.

(OR)

b) Find the equation to the right circular cone whose vertex is P(2,-3,5) axis PQ which makes equal angles with the axes and which passes through A(1,-2,3).

Minor-1. Differential Equations

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Solve first order first degree linear differential equations.

CO2. Convert a non-exact homogeneous equation to exact differential equation by using an integrating factor.

CO3. Know the methods of finding solution of a differential equation of first order but not of first degree.

CO4. Solve higher-order linear differential equations for both homogeneous and non-homogeneous, with constant coefficients.

CO5. Understand and apply the appropriate methods for solving higher order differential equations.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

Differential Equations of first order and first degree

Linear Differential Equations – Bernoulli's Equations - Exact Differential Equations –Integrating factors - Equations reducible to Exact Equations by Integrating Factors - i) Inspection Method ii) $\frac{1}{Mx+Ny}$ iii) $\frac{1}{Mx-Ny}$

Unit – 2

Differential Equations of first order but not of first degree

Equations solvable for p, Equations solvable for y, Equations solvable for x – Clairaut's equation - Orthogonal Trajectories: Cartesian and Polar forms.

Unit – 3

Higher order linear differential equations

Solutions of homogeneous linear differential equations of order n with constant coefficients - Solutions of non-homogeneous linear differential equations with constant coefficients by means of polynomial operators

(i) $Q(x) = e^x$ (ii) $Q(x)$ = $Sin\ ax$ (or) $Cos\ ax$ ax

Unit – 4

Higher order linear differential equations (continued.)

Solution to a non-homogeneous linear differential equation with constant coefficients

P.I. of (D) = Q when Q = bx^k

P.I. of (D) = Q when Q = $e^{ax}V$, where V is a function of x

P.I. of (D) = Q when Q = xV, where V is a function of x

Unit – 5

Higher order linear differential equations with non-constant coefficients

Linear differential Equations with non-constant coefficients; Cauchy-Euler Equation; Legendre Equation; Method of variation of parameters.

Activities
Seminar/ Quiz/ Assignments/ Applications of Differential Equations to Real life Problem /Problem Solving Sessions.

Text Book
Differential Equations and Their Applications by Zafar Ahsan, published by Prentice-Hall of India Pvt. Ltd, New Delhi-Second edition.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Ordinary and Partial Differential Equations by Dr. M.D. Raisinghania, published by S. Chand &Company, New Delhi.
2. Differential Equations with applications and programs – S. Balachandra Rao & HR Anuradha- Universities Press.
3. Differential Equations -Srinivas Vangala &Madhu Rajesh, published by Spectrum University Press.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 3. Differential Equations				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Differential Equations of first order and first degree	2	2	24
II	Differential Equations of first order but not of first degree	2	2	24
III	Higher order linear differential equations	1	2	22
IV	Higher order linear differential equations (continued.)	2	2	24
V	Higher order linear differential equations with non-constant coefficients	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

1st B.Sc., SECOND SEMESTER MATHEMATICS MODEL PAPER

Minor-01. DIFFERENTIAL EQUATIONS

PART-A

Answer any FIVE questions from the following **5x2 =10M**

1. Solve (e^y+1) Cosx dx + e^y sinx dy = 0
2. Solve $(y - xy^2)$ dx - $(x + x^2y)$ dy = 0

3. Solve $x + yp^2 = (1+ xy)p$

4. Solve $(y – xp)(p – 1) = p$

5. Solve $(D^4 – 4D^3 + 6D^2 – 4D + 1)y = 0$

6. Find the particular values of $\frac{1}{(D-2)(D-3)} e^{2x}$

7. Find the complementary functions of $(D^4 + 2D^2 + 1) y = x^2 \cos x$

8. Find the complementary function of $(x^2D^2 + 2xD – 12) y = x^3 \log x$

PART – B

Answer any FIVE questions from the following **5x10 = 50M**

9. a) Solve $y^2 dx + (x^2 – xy – y^2) dy = 0$

(OR)

b) Solve $x\frac{dy}{dx} + y = y^2 \log x$

10.a) Find the orthogonal trajectories of the family of curves $\frac{x^2}{a^2} + \frac{y^2}{a^2+\lambda} = 1$, where λ is the parameter

(OR)

b) Solve $y + px = p^2 x^4$

11. a) Solve $(D^3 – 5D^2 + 7D – 3) y = e^{2x} \cosh x$

(OR)

b)Solve $(D^2 – 4D + 3) y = \sin 3x \cos 2x$

12.a) Solve $(D^4 + D^2) y = 3x^2 + 4\sin x – 2\cos x$

(OR)

b)Solve $\frac{d^2y}{dx^2} + 3\frac{dy}{dx} + 2y = xe^x \sin x$

13. a) Solve $(D^2 – 2D + 2) y = e^x \tan x$ by the method of variation of parameters

(OR)

b) Solve $[(1+ 2x^2)^2 D^2 – 6(1+ 2x) D + 16] y = 8(1+2x)$

SEMESTER-III

3. GROUP THEORY

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Acquire the basic knowledge and structure of groups

CO2. Get the significance of the notation of a subgroup and cosets.

CO3. Understand the concept of normal subgroups and properties of normal subgroup.

CO4. Study the homomorphisms and isomorphisms with applications.

CO5. Understand the properties of permutation and cyclic groups.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔			✔							✔		✔		
CO02	✔	✔	✔	✔		✔	✔	✔			✔		✔		
CO03	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔		✔		✔		✔	✔	✔	✔	
CO05	✔			✔							✔		✔		

Course Content

Unit – 1

Groups

Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

Unit – 2

Sub Groups

Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition-examples-criterion for a complex to be a subgroups; Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. Coset Definition – properties of Cosets – Index of subgroups of finite groups – Lagrange's Theorem.

Unit – 3

Normal Subgroups

Normal Subgroups: Definition of normal subgroup – proper and improper normal subgroup– Hamilton group- Criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups Sub group of index 2 is a normal sub group

Unit – 4

Homomorphisms

Quotient groups, Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

Unit – 5

Permutations and Cyclic Groups

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley's theorem.

Cyclic Groups - Definition of cyclic group – elementary properties – classification of cyclic groups.

Activities
Seminar/ Quiz/ Assignments/ Applications of Group Theory to Real life Problem /Problem Solving Sessions.

Text Book Modern Algebra by A.R.Vasishtha and A.K.Vasishtha, KrishnaPrakashanMedia Pvt. Ltd., Meerut.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna, Jai Prakash and Co. Printing Press, Meerut
3. Rings and Linear Algebra by Pundir&Pundir, published by Pragathi Prakashan.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 4. Group Theory				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Groups	2	2	24
II	Sub Groups	2	2	24
III	Normal Groups	1	2	22
IV	Homomorphisms	2	2	24
V	Permutations and Cyclic Groups	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Paper – V: Group Theory MODEL PAPER

Time: 2 ½ Hours **Max. Marks: 60**

Section – A

Answer any **FIVE** questions. Each question carries **TWO** marks. (5 X 2 = 10M)

1. Prove that cancellation laws hold in a group (G , .)
2. Find the order of each element of the group $G = z_6 = \{0,1,2,3,4,5,6\}$, the composition being addition modulo 6.
3. If H is any subgroup of a group G, then $H^{-1} = H$.
4. If H is a subgroup of group (G, +). Then find all cosets of H in G. where G is the additive group of integers.
5. Prove that the intersection of any two normal subgroups of a group is a normal subgroup.
6. Prove that every group of prime order is simple.
7. If for a group $G, f: G \to G$ is given by $f(x) = x^2, x \in G$ is a homeomorphism, prove that G is abelian.
8. Find the order of the cycle (1 4 5 7)

Section – B

Answer **ALL** the questions. Each question carries **TEN** marks. 5 X 10 = 50M

9. A) Show that set Q_+ of all +ve national number forms an abelian group under the composition defined by "o" such that $a \ o \ b = \frac{(ab)}{3} \ for \ a, b \in Q.$

(OR)

B) Prove that A finite semi-group (G, **.**) satisfying the cancellation laws is a group.

10. A) If it is a non-empty complex of a group G. The necessary and sufficient condition for H to be a subgroup of G is $a, b \in H \Rightarrow ab^{-1} \in H$ where $b^{-1}$the inverse of b in G. is

(OR)

B) State and prove Lagrange's theorem.

11. A) If H is a subgroup of G and N is a normal subgroup of G, then

i) $H \cap N$ is a normal subgroup of H.

ii) N is a normal subgroup of HN.

(OR)

B) A subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G.

12. A) State and prove fundamental theorem on homomorphism of groups.

(OR)

B) The necessary and sufficient condition for a homomorphism f of a group G onto a group G with kernel k to be an isomorphism of G into G'is that k={e}.

13. A) State and prove Cayley's Theorem.

(OR)

B) Every subgroup of cyclic group is cyclic.

SEMESTER-III

4. NUMERICAL METHODS

Course Outcomes

After successful completion of this course, the student will be able to

CO1. difference between the operators □,□,E and the relation between them

CO2. know about the Newton – Gregory Forward and backward interpolation

CO3.know the Central Difference operators □□,□,□□and relation between them

CO4.solve Algebraic and Transcendental equations

CO5. Understand the concept of Curve fitting

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

The calculus of finite differences

The operators □,□,E - Fundamental theorem of difference calculus- properties of □,□,E and problems on them to express any value of the function in terms of the leading terms and the leading differences - relations between E and D - relation between D and □□- problems on one or more missing
terms- Factorial notation- problems on separation of symbols- problems on Factorial notation.

Unit – 2

Interpolation with equal and unequal intervals

Derivations of Newton – Gregory Forward and backward interpolation and problems on them. Divided differences - Newton divided difference formula - Lagrange's and problems on them.

Unit – 3

Central Difference Interpolation formulae

Central Difference operators □□,□,□□and relation between them - Gauss forward formula for equal intervals - Gauss Backward formula - Stirlings formula - Bessel's formula and problems on the above
formulae.

Unit – 4

Solution of Algebraic and Transcendental equation

Method for finding initial approximate value of the root - Bisection method - to find the solution of given equations by using (i) Regula Falsi method (ii) Iteration method (iii) Newton – Raphson's method and problems on them.

Unit – 5

Curve Fitting

Least-squares curve fitting procedures - fitting a straight line-nonlinear curve fitting-curve fitting by a
sum of exponentials.

Activities
Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.

Text Book
Numerical Analysis by G. Shanker Rao, New Age International Publications

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Applied Numerical Analysis by Curtis F. Gerald and Patrick O. Wheatley, Pearson,(2003) 7th Edition
2.Introductory Methods of Numerical Analysis by S.S. Sastry, (6th Edition) PHI New Delhi 2012
3. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S .R. K. Iyengar and R. K. Jain, New Age International Publishers (2012), 6th edition.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 4. Numerical methods				
UNIT	**TOPICS**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	The calculus of finite differences	2	2	24
II	Interpolation with equal and unequal intervals	2	2	24
III	Central Difference Interpolation formulae	1	2	22
IV	Solution of Algebraic and Transcendental equation	2	2	24
V	Curve Fitting	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Maharajah's College (Autonomous):: Vizianagaram-2

II B.sc., THIRD SEMESTER- MODEL PAPER

MAJOR MATHEMATICS (Admitted batch: 2023-27)

COURSE-7: NUMERICAL METHODS

Time: 2 ½ Hours Max. Marks: 60

Section – A

1. Answer any **FIVE** questions. Each question carries **TWO** marks. 5x2=10M

a) Define Forward difference operator.

b) Prove that $\Delta = E - 1$.

c) Define Newton divided difference formula.

d) Define Averaging operator.

e) Prove that $\mu^2 = 1 + \frac{1}{4}\delta^2$

f) Evaluate $\sqrt{12}$ by iteration method.

g) Write the Normal equations for least square straight line .

h) Find a curve $y = a.e^x$ to the data :

x	0	2	4
y	5.1	10	31.4

Section – B

Answer **ALL** the questions. Each question carries **TEN** marks. 5 X 10 = 50M

2. A) State and prove fundamental theorem of differences calculus.

(OR)

B) Find the missing entries in the following table.

X	0	1	2	3	4	5
Y = f(x)	0	-	8	15	-	35

3. A) State and prove the Newton – Gregory forward interpolation formula.

(OR)

B) Using Lagrange's interpolation formula find f(2) for the following table.

x	0	1	3	4
f(x)	5	6	50	105

4. A) Find by Gauss's Backward interpolation formula the value of y at x = 1936 using the following table:

x	1901	1911	1921	1931	1941	1951
y	12	15	20	27	39	52

(OR)

B) Use Stirling's formula to find y_{28} , given $y_{20} = 49225$, $y_{25} = 48316$, $y_{30} = 47236$, $y_{35} = 45926$, $y_{40} = 44306$.

5. A) Find root of the equation x^3-4x-9 = 0 using the Bisection method in four stages.

(OR)

B) Find a real root of x^3-x-2 = 0 using Newton-Raphson method.

6. A) Explain the procedure to fit a straight line by the method of least squares.

(OR)

B) Determine constants a, b, and c by the method of least squares y = a+bx+cx^2 fits the following data.

x	2	4	6	8	10
y	3.07	12.85	31.47	57.38	91.29

SEMESTER-III

COURSE 7: LAPLACE TRANSFORMS

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand the definition and properties of Laplace transformations

CO2. Get an idea about first and second shifting theorems and change of scale property

CO3. Understand Laplace transforms of standard functions like Bessel, Error function etc

CO4. Know the reverse transformation of Laplace and properties

CO5. Get the knowledge of application of convolution theorem.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

LAPLACE TRANSFORMS – I

Definition of Laplace Transform - Linearity Property - Piecewise Continuous Function - Existence of Laplace Transform - Functions of Exponential order and of Class A.

Unit – 2

LAPLACE TRANSFORMS – II

First Shifting Theorem, Second Shifting Theorem, Change of Scale Property, Laplace transform of the derivative of f(t), Initial value theorem and Final value theorem.

Unit – 3

LAPLACE TRNASFORM – III

Laplace Transform of Integrals - Multiplication by t, Multiplication by tn - division by t -Laplace transform of Bessel Function - Laplace Transform of Error Function - Laplacetransform of Sine and Cosine integrals.

Unit – 4

INVERSE LAPLACE TRANSFORMS – I

Definition of Inverse Laplace Transform - Linearity Property - First Shifting Theorem -Second Shifting Theorem - Change of Scale property - use of partial fractions - Examples.

Unit – 5

INVERSE LAPLACE TRANSFORMS – II

Inverse Laplace transforms of Derivatives - Inverse Laplace Transforms of Integrals -Multiplication by Powers of 'p' - Division by powers of 'p' - Convolution Definition -Convolution Theorem - proof and Applications - Heaviside's Expansion theorem and its Applications.

Activities
Seminar/ Quiz/ Assignments/ Applications of Laplace Transforms to Real life Problem /Problem Solving Sessions.

Text Book
LaplaceTransforms by A.R.Vasishtha,Dr.R.K.Gupta,KrishnaPrakashanMedia Pvt.Ltd., Meerut.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Introduction to Applied Mathematics by Gilbert Strang, Cambridge Press
2. Laplace and Fouries transforms by Dr.J.K. Goyal and K.P. Guptha, PragathiPrakashan, Meerut.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 7: LAPLACE TRANSFORMS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	LAPLACE TRANSFORMS – I	2	2	24
II	LAPLACE TRANSFORMS – II	2	2	24
III	LAPLACE TRANSFORMS – III	1	2	22
IV	INVERSE LAPLACE TRANSFORMS – I	2	2	24
V	INVERSE LAPLACE TRANSFORMS – II	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

LAPLACE TRANSFORMS MODEL QUESTION PAPER

SECTION-A

ANSWER ANY FIVE OF THE FOLLOWING QUESTIONS 5X2=10

1. Find the Laplace transform of $\{7e^{2t} + 9e^{-2t} + 5\cos t + 7t^3 + 5\sin t + 2\}$
2. Find the Laplace transform of $\{\sin 2t \cos 3t\}$
3. Find $L\{(t+3)^2 e^t\}$
4. Find $L\{\cos 4t\}$ by using change of scale property
5. Find the Laplace transform of $\int_0^t e^{-t} \sin ht \, dt$
6. Evaluate $\int_0^\infty te^{-t} \sin t \, dt$
7. Find $L^{-1}\left\{\frac{p+3}{p^2-10p+29}\right\}$

8. Find $L^{-1}\left\{\frac{p}{(p+2)^2}\right\}$

SECTION-B

ANSWER ANY FIVE OF THE FOLLOWING QUESTIONS

5X10=50

9. (a) Find the Laplace transform of $(\sin t - \cos t)^3$

(OR)

(b) Find the Laplace transform of $f(t) = |t-1| + |t+1|, t \geq 0$

10. (a)State and prove Second Shifting Theorem

(OR)

(b) State and prove Final Value Theorem

11. (a) Find the Laplace transform of $(t^3 \cos at)$

(OR)

(b) Find $L\left\{\frac{1-\cos t}{t^2}\right\}$

12. (a) Find $L^{-1}\left\{\frac{p^2}{(p+1)(p+2)(p+3)}\right\}$

(OR)

(b) Find $L^{-1}\left\{\frac{1}{(p+1)^2(p^2+4)}\right\}$

13. (a)State and prove Heaviside's Expansion Theorem

(OR)

(b)Using convolution theorem find $L^{-1}\left\{\frac{p^2}{(p^2+a^2)(p^2+b^2)}\right\}$

SEMESTER-III
COURSE 8: SPECIAL FUNCTIONS

Course Outcomes
After successful completion of the course will be able to
CO1. Understand the Beta and Gamma functions, their properties and relation between these two functions, understand the orthogonal properties of Chebyshev polynomials and recurrence relations.

CO2. Find power series solutions of ordinary differential equations.

CO3. Solve Hermite equation and write the Hermite Polynomial of order (degree) n, also Find the generating function for Hermite Polynomials, study the orthogonal properties of Hermite Polynomials and recurrence relations.

CO4. Solve Legendre equation and write the Legendre equation of first kind, also find the generating function for Legendre Polynomials, understand the orthogonal properties of Legendre Polynomials.

CO5. Solve Bessel equation and write the Bessel equation of first kind of order n, also find the generating function for Bessel function understand the orthogonal properties of Bessel unction.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content
Unit–1
Beta and Gamma functions, Chebyshev polynomials
Euler's Integrals-Beta and Gamma Functions, Elementary properties of Gamma Functions, Transformation of Gamma Functions. Another form of Beta Function, Relationbetween Beta and Gamma Functions. Chebyshev polynomials, orthogonal properties of Chebyshev polynomials, recurrence relations, generating functions for Chebyshev polynomials.
Unit–2
PowerseriesandPowerseriessolutionsofordinarydifferentialequations
Introduction, summary of useful results, powerseries, radiusofconvergence, theorems on Power series Introduction of power series solutions of ordinary differential equation Ordinary and singular points, regular and irregular singular points, power series solution.
Unit–3
Hermitepolynomials
Hermite Differential Equations, Solution of Hermite Equation,Hermite polynomials, generating function for Hermite polynomials. Other forms for Hermite Polynomials, Rodrigues formula for Hermite Polynomials, to find first few Hermite Polynomials. Orthogonal properties of Hermite Polynomials, Recurrence formulae for Hermite polynomials.

Unit–4

Legendrepolynomials

Definition,Solution of Legendre'sequation,Legendre polynomial of degree n, generating function of Legendre polynomials. Definition of $Pn(x)$ and $Qn(x)$, General solution of Legendre's Equation (derivations not required) to show that $Pn(x)$ is the coefficient of hn, in the expansion of $(1-2xh+h2)^{-1/2}$ Orthogonal Properties of Legendre's polynomials ,Recurrence formulas for Legendre's Polynomials.

Unit–5

Bessel'sequation

Definition,Solution of Bessel's equation,Bessel's function of the first kind of order n,Bessel's function of the second kind of order n. Integration of Bessel's equation in series form =0, Definition of *Jn(x)*,*Jn(x)* Generating function for *Jn(x)* orthogonally of Bessel functions.

Activities

Seminar/ Quiz/ Assignments/ Applications of Special functions to Real life Problem /Problem Solving Sessions.

Text Book

Special Functions by J.N.Sharma and Dr.R.K.Gupta, Krishna Prakashan,

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

ReferenceBooks

1. Dr.M.D.Raisinghania, Ordinary and Partial Differential Equations, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-110055.

2. Shanti Narayan and Dr.P.K.Mittal, Integral Calculus, S. Chand &CompanyPvt. Ltd., Ram Nagar, New Delhi-110055.

3. GeorgeF.Simmons,Differential Equations with ApplicationsandHistoricalNotes,Tata McGRAW-Hill Edition, 1994.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 8: SPECIAL FUNCTIONS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Beta and Gamma functions, Chebyshev polynomials	2	2	24
II	PowerseriesandPowerseriessolution sofordinarydifferentialequations	2	2	24
III	Hermitepolynomials	1	2	22
IV	Legendrepolynomials	2	2	24
V	Bessel'sequation	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Mathematical Special Functions MODEL QUESTION PAPER

SECTION -A

Answer any Five Questions **5×2 =10 M**

1. $\int_0^1 X^4\ (1-X)^3\,dx = \frac{1}{280}$

2. Prove that $\Gamma(\frac{1}{2}) = \sqrt{\pi}$.

3 Find the Radius of convergence of the following series

$\frac{1}{2}x + \frac{1.3}{2.5}.x^2 + \frac{1.3.5}{2.5.8}.x^3 + \ldots\ldots\ldots\ldots$

4. Prove that $2xH_n(x) = 2n\,H_{n-1}(x) + H_{n+1}(x)$.

5. Prove that if m < n then $\frac{dm}{dx^m}(H_n(x)) = \frac{2^m\,n!}{(n-m)!}H_{n-m}(x)$.

6. $(2n+1).x.p_n(x)=(n+1)p_{n+1}(x) + n.p_{n-1}(x)$

7. Show that $J_{1/2}(x) = \sqrt{\frac{2}{\pi x}}\sin x$.

8. Show that $x\,J^I_n(x) = -n\,J_n(x) + x\,J_{n-1}(x)$.

SECTION B

Answer all the questions. **5x10=50M**

9. a) Prove that $\beta(m, n) = \frac{\Gamma m\,\Gamma n}{\Gamma(m+n)}$.

OR

b). Show that (i) $\int_{-1}^{1}\frac{T_m(x)T_n(x)}{\sqrt{1-x^2}}dx = \begin{cases} 0 \ , & if\ m \neq n \\ \frac{\pi}{2}\ , & if\ m = n \neq 0 \\ \pi\ , & if\ m = n = 0 \end{cases}$

(ii) $\int_{-1}^{1}\frac{U_m(x)U_n(x)}{\sqrt{1-x^2}}dx = \begin{cases} 0 \ , & if\ m \neq n \\ \frac{\pi}{2}\ , & if\ m = n \neq 0 \\ 0\ , & if\ m = n = 0 \end{cases}$

10. a) Show that **x=0** is an Irregular singular point and x=-1 is a Regular singular point of $x^2(x+1)^2y^{II}+(x^2+1)y^I+2Y=0$.

OR

b) Find the Power series solution of $(x^2-1).y^{II} + x.y^I - y=0$

11. a) State and prove that Rodrigues formula for Hermite Polynomials.

OR

b) State and Prove that Generating function of Hermit Polynomials.

12). a) Prove that $(1-2xh+h^2)^{-1/2} = \sum_{n=0}^{\infty} h^n P_n(x)$

OR

b) State and Prove Orthogonal properties of Legendre Polynomials for $P_n(X)$

13 a) Prove that $Y = a_0(1-\frac{x^2}{2^2} + \frac{x^4}{2^2 4^2} - \frac{x^6}{2^2 4^2 6^2} + \ldots\ldots)$ is a solution of Bessel's differential equation for n = 0

OR

b) Show that i) $J_{-n}(x) = (-1)^n J_n(x)$ where n is a positive integer and

ii) $J_n(-x) = (-1)^n J_n(x)$ for positive or negative integers.

MINOR-2. GROUP THEORY

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Acquire the basic knowledge and structure of groups

CO2. Get the significance of the notation of a subgroup and cosets.

CO3. Understand the concept of normal subgroups and properties of normal subgroup.

CO4. Study the homomorphisms and isomorphisms with applications.

CO5. Understand the properties of permutation and cyclic groups.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔			✔							✔		✔		
CO02	✔	✔	✔	✔		✔	✔	✔			✔		✔		
CO03	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔		✔		✔		✔	✔	✔	✔	
CO05	✔			✔							✔		✔		

Course Content

Unit – 1
Groups

Binary Operation – Algebraic structure – semi group-monoid – Group definition and elementary properties Finite and Infinite groups – examples – order of a group, Composition tables with examples.

Unit – 2
Sub Groups

Complex Definition – Multiplication of two complexes Inverse of a complex-Subgroup definition-examples-criterion for a complex to be a subgroups; Criterion for the product of two subgroups to be a subgroup-union and Intersection of subgroups. Coset Definition – properties of Cosets – Index of subgroups of finite groups – Lagrange’s Theorem.

Unit – 3
Normal Subgroups

Normal Subgroups: Definition of normal subgroup – proper and improper normal subgroup– Hamilton group- Criterion for a subgroup to be a normal subgroup – intersection of two normal subgroups Sub group of index 2 is a normal sub group

Unit – 4
Homomorphisms

Quotient groups, Definition of homomorphism – Image of homomorphism elementary properties of homomorphism – Isomorphism – automorphism definitions and elementary properties–kernel of a homomorphism – fundamental theorem on Homomorphism and applications.

Unit – 5
Permutations and Cyclic Groups

Definition of permutation – permutation multiplication – Inverse of a permutation – cyclic permutations – transposition – even and odd permutations – Cayley’s theorem.

Cyclic Groups - Definition of cyclic group – elementary properties – classification of cyclic groups.

Activities
Seminar/ Quiz/ Assignments/ Applications of Group Theory to Real life Problem /Problem Solving Sessions.

Text Book Modern Algebra by A.R.Vasishtha and A.K.Vasishtha, KrishnaPrakashanMedia Pvt. Ltd., Meerut.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Abstract Algebra by J.B. Fraleigh, Published by Narosa publishing house.
2. Modern Algebra by M.L. Khanna, Jai Prakash and Co. Printing Press, Meerut
3. Rings and Linear Algebra by Pundir&Pundir, published by Pragathi Prakashan.

BLUE PRINT FOR PREPARING QUESTION PAPER				
Course 4. Group Theory				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Groups	2	2	24
II	Sub Groups	2	2	24
III	Normal Groups	1	2	22
IV	Homomorphisms	2	2	24
V	Permutations and Cyclic Groups	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Minor-2: Group Theory MODEL PAPER

Time: 2 ½ Hours Max. Marks: 60

Section – A

1.Answer any **FIVE** questions. Each question carries **TWO** marks. (5 X 2 = 10M)

a) Prove that cancellation laws hold in a group (G , .)
b) Find the order of each element of the group $G = z_6 = \{0,1,2,3,4,5,6\}$, the composition being addition modulo 6.
c) If H is any subgroup of a group G, then $H^{-1} = H$.
d) If H is a subgroup of group (G, +). Then find all cosets of H in G. where G is the additive group of integers.
e) Prove that the intersection of any two normal subgroups of a group is a normal subgroup.
f) Prove that every group of prime order is simple.
g) If for a group $G, f: G \to G$ is given by $f(x) = x^2, x \in G$ is a homeomorphism, prove that G is abelian.
h) Find the order of the cycle (1 4 5 7)

Section – B

Answer **ALL** the questions. Each question carries **TEN** marks. 5 X 10 = 50M

2. A) Show that set Q_+ of all +ve national number forms an abelian group under the composition defined by "o" such that $a\ o\ b = \frac{(ab)}{3}\ for\ a, b \in Q.$

(OR)

B) Prove that A finite semi-group (G, **.**) satisfying the cancellation laws is a group.

3. A) If it is a non-empty complex of a group G. The necessary and sufficient condition for H to be a subgroup of G is $a, b \in H \Rightarrow ab^{-1} \in H$ where $b^{-1}$the inverse of b in G. is

(OR)

B) State and prove Lagrange's theorem.

4. A) If H is a subgroup of G and N is a normal subgroup of G, then

iii) $H \cap N$ is a normal subgroup of H.

iv) N is a normal subgroup of HN.

(OR)

B) A subgroup H of a group G is a normal subgroup of G iff the product of two right cosets of H in G is again a right coset of H in G.

5. A) State and prove fundamental theorem on homomorphism of groups.

(OR)

B) The necessary and sufficient condition for a homomorphism f of a group G onto a group G with kernel k to be an isomorphism of G into G'is that k={e}.

6. A) State and prove Cayley's Theorem.

(OR)

B) Every subgroup of cyclic group is cyclic.

SEMESTER-IV
COURSE 9: RING THEORY

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Acquire the basic knowledge of rings, fields and integral domains

CO2. Get the knowledge of subrings and ideals

CO3. Construct composition tables for finite quotient rings

CO4. Study the homomorphisms and isomorphisms with applications.

CO5. Get the idea of division algorithm of polynomials over a field.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

Rings and Fields

Definition of a ring and Examples –Basic properties – Boolean rings - Fields – Divisors of 0 and Cancellation Laws– Integral Domains – Division ring - The Characteristic of a Ring, Integral domain and Field – Non Commutative Rings - Matrices over a field – The Quaternion ring.

Unit – 2

Sub rings and Ideals

Definition and examples of Sub rings – Necessary and sufficient conditions for a subset to be a sub ring – Algebra of Sub rings – Centre of a ring – left, right and two sided ideals – Algebra of ideals – Equivalence of a field and a commutative ring without proper ideals

Unit -3

Principal ideals and Quotient rings

Definition of a Principal ideal ring (Domain) – Every field is a PID – The ring of integers is a PID – Example of a ring which is not a PIR – Cosets – Algebra of cosets – Quotient rings – Construction of composition tables for finite quotient rings of the ring Z of integers and the ring $Zn$of integers modulo n.

Unit – 4

Homomorphism of Rings

Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorems of homomorphism of rings – Maximal and prime Ideals – Prime Fields

Unit – 5

Rings of Polynomials

Polynomials in an indeterminate – The Evaluation morphism -- The Division Algorithm in $F[x]$ – Irreducible Polynomials – Ideal Structure in $F[x]$ – Uniqueness of Factorization $F[x]$.

Activities
Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Text book
Modern Algebra by A.R.Vasishta and A.K.Vasishta, Krishna Prakashan Media Pvt. Ltd.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference books

1. A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
2. Linear Algebra by Stephen. H. Friedberg and Others,Pearson Education India.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 9: RING THEORY(MAJOR)				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Rings and Fields	2	2	24
II	Sub rings and Ideals	2	2	24
III	Principal ideals and Quotient rings	1	2	22
IV	Homomorphism of Rings	2	2	24
V	Rings of Polynomials	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

RING THEORY MODEL PAPER

Time:3Hrs. **Max.Marks: 60M**

PART-A

1. Answer any 5(FIVE)of the following : **5X2=10 M**

a. Define Ring.

b. If R is an Boolean Ring then a + a = 0 $\forall\ a \in R$.

c. Prove that the Intersection of two sub-rings of a Ring R is a sub ring.

d. Define Ideal.

e. Define Principle Ideal Ring.

f. Define Quotient Ring.

g. Define Kernal of a Homomorphism.

h. Define Irreducible Polynomial.

PART-B

Answer <u>ALL</u> the following Questions: **5X10=50M**

2. a) Prove that every finite integral domain is a field.

(Or)

b) Prove that Q($\sqrt{2}$) = {a+b$\sqrt{2}$ / $a, b \in R$ } is a field w.r.t. ordinary addition and multiplication of numbers.

3. a) Prove that a field has no Proper Non-Trivial Ideas.

(Or)

b) if U_1 and U_2 are two ideals of a Ring R then Prove that U_1 U U_2 is an ideal of ring R if and only if $U_1 \subset U_2$ (or) $U_2 \subset U_1$

4. a) Prove that the ring of integers 'Z is a principal ideal ring.

(Or)

b) If R/U is the Quotient Ring prove that

i) R/U is commutative if R is commutative and

ii) R/U has unity element if R has unity element.

5. a) State and prove fundamental theorem of homomorphism of rings.

(Or)

b) Prove that an ideal U of a commutative ring R with unity is maximal if and only if the quotient of Ring R/U is a field.

6. a) Prove that Let F be a field Given Two polynomials f(x), g(x) $\neq 0(x)$ in f (x) there exist unique polynomials q(x) and r(x) in f(x) such that f(x) = q(x)g(x)+r(x) where r(x) = 0(x) or deg r(x) < deg g(x).

(Or)

b) if f {x} is a set of all polynomials over a Field f then every ideal in f{x} is a principal ideal.

SEMESTER-IV
COURSE 10: INTRODUCTION TO REAL ANALYSIS

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Get clear idea about the real numbers and real valued functions.

CO2. Obtain the skills of analyzing the concepts and applying appropriate methods fortesting convergence of a sequence/ series.

CO3. Test the continuity and differentiability and Riemann integration of a function.

CO4. Know the geometrical interpretation of mean value theorems.

CO5. Know about the fundamental theorem of integral calculus.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Contents

Unit – 1
REALNUMBERS, REAL SEQUENCES

The algebraic and order properties of R - Absolute value and Real line - Completeness property of R - Applications of supremum property - intervals. (**No question is to be set from this portion)** Sequences and their limits -Range and Boundedness of Sequences - Limit of a sequence and Convergent sequence -The Cauchy’s criterion - properly divergent sequences - Monotone sequences - Necessary and Sufficient condition for Convergence of Monotone Sequence - Limit Point of Sequence -Subsequences and the Bolzano-weierstras’s theorem – Cauchy Sequences – Cauchy’s general principle of convergence.

Unit – 2
INFINITIE SERIES

Introduction to series –convergence of series -Cauchy’s general principle of convergence for series tests for convergence of series - Series of non-negative terms - P-test - Cauchy’s nth root test -D’-Alembert’s Test-Alternating Series–Leibnitz Test.

Unit –3
LIMIT & CONTINUITY

Real valued Functions – Bounded ness of a function - Limits of functions - Some extensions of the limit concept - Infinite Limits - Limits at infinity **(No question is to be set from this portion).**Continuous functions - Combinations of continuous functions - Continuous Functions on intervals - uniform continuity.

Unit – 4
DIFFERENTIATION AND MEAN VALUE THEOREMS

The derivability of a function at a point and on an interval - Derivability and continuity of a function –Mean value Theorems -Rolle’sTheorem, Lagrange’s Theorem, Cauchy’s Mean value Theorem

Unit – 5
RIEMANN INTEGRATION

Riemann Integral - Riemann integral functions - Darboux theorem -Necessary and sufficient condition for R integrability - Properties of integrable functions - Fundamental theorem of integral calculus - integral as the limit of a sum - Mean value Theorems.

Activities

Seminar/ Quiz/ Assignments/ Applications of Real Analysis to Real life Problem /Problem Solving Sessions.

TextBook

An Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, John Wiley and sonsPvt. Ltd

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

ReferenceBooks

1. ElementsofRealAnalysis by ShanthiNarayan andDr.M.D.Raisinghania, S. Chand & Company Pvt. Ltd., New Delhi.
2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 10: INTRODUCTION TO REAL ANALYSIS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	REALNUMBERS, REAL SEQUENCES	2	2	24
II	INFINITIE SERIES	2	2	24
III	LIMIT & CONTINUITY	1	2	22
IV	DIFFERENTIATION AND MEAN VALUE THEOREMS	2	2	24
V	RIEMANN INTEGRATION	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

REAL ANALYSIS MODEL PAPER

Time: 2 ½ Hours **Max. Marks: 60M**

Section – A

1.Answer any **FIVE** questions, each question carries **TWO** marks. 5 X 2 = 10M

a) Prove that every convergent sequence is bounded.

b) Using sandwich theorem prove that $\lim_{n\to\infty}(\sqrt{n^2+n}-n)=\frac{1}{2}$

c) If $\sum u_n$ be a convergent series of positive terms, show that $\sum {u_n}^2$ is convergent.

d) Test for convergent $\sum\frac{2^n}{n^3}$

e) Let f be defined by $f(x)=\frac{(x^2+x-6)}{(x-2)}$ for $x\in R\backslash\{2\}$. Can f be defined at $x=2$ in such a way that f is continuous at this point?

f) Show that the function f defined by $f(x)=x^3$ is uniformly continuous in [-2, 2].

g) Show that $f(x)=x\sin\left(\frac{1}{2}\right), x\neq 0, x=0$ is continuous but not derivable at x=0.

h) If $f(x)=x^2\ on\ [0,1]\ \ and\ \ p=\{0,\frac{1}{4},\frac{2}{4},\frac{3}{4},\dots\dots\}$ compute L(p, f) and U(p,f)

Section – B

Answer **AL**L following questions. Each question carries **TEN** marks. (5 X 10 = 50M)

2. A) Prove that a monotone sequence is convergent if and only if it is bounded.

(OR)

B) Prove that a sequence $\{s_n\}$ is convergent iff to each $\in>0$ there exists $m\in z^+$ such that $|s_{n+p}-s_n|<\in$, for all $n\geq\ m\ and\ p>0$.

3. A) State and prove p-series test.

(**OR)**

B) Test for convergence

$a)\ \sum_{n=1}^{\infty}\left(\sqrt{n^3+1}-\sqrt{n^3}\right)$ $b)\ \sum_{n=1}^{\infty}(\sqrt{n^4+1}-\sqrt{n^4-1})$

4. A) Examine for continuity the function f define by $f(x)=|x|+|x-1|\ \ at\ \ x=0,1$.

(OR)

B) If $f: I=[a,b]\to R$ is continuous on [a, b], then f is bounded on [a, b] and attains its bounds or infimum and supremum.

5. A) Show that $\frac{v-u}{1+v^2}<Tan^{-1}v\,.Tan^{-1}u<\frac{v-u}{1+u^2}$ for 0<u<v. Hence deduce that $\frac{\pi}{4}+\frac{3}{25}<Tan^{-1}\frac{4}{3}<\frac{\pi}{4}+\frac{1}{6}$

(OR)

B) State and prove Cauchy's mean value theorem.

6. A) Prove that $f(x)=x^2$ is integrable on [0,a] and $\int_0^a x^2dx=\frac{a^3}{3}$

(OR)

B) State and prove fundamental theorem of integral calculus.

SEMESTER-IV

COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS

Course Outcomes

Students after successful completion of the course will be able to

CO1. Understand the application of Laplace transforms to solve ODEs

CO2. Understand the application of Laplace transforms to solve Simultaneous DEs

CO3. Understand the application of Laplace transforms to Integral equations

CO4. Basic knowledge of Fourier-Transformations

CO5. Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

Application of Laplace Transform to solutions of Differential Equations

Solutions of ordinary Differential Equations - Solutions of Differential Equations with constants coefficients - Solutions of Differential Equations with Variable coefficients.

Unit – 2

Application of Laplace Transform to solutions of Differential Equations

Solutions of Simultaneous Ordinary Differential equations - Solutions of Partial Differential Equations.

Unit – 3

Application of Laplace Transforms to Integral Equations

Definitions of Integral Equations - Abel's Integral Equation - Integral Equation of Convolution Type - Integral Differential Equations - Application of L.T. to Integral Equations.

Unit – 4

Fourier Transforms - I

Definition of Fourier Transform - Fourier sine Transform - Fourier cosine Transform - Linear Property of Fourier Transform - Change of Scale Property for Fourier Transform - sine Transform and cosine transform shifting property - Modulation theorem.

Unit – 5

Fourier Transforms – II

Definition of Convolution - Convolution theorem for Fourier transform - Parseval's Identity - Relationship between Fourier and Laplace transforms - problems related to Integral Equations -Finite Fourier Transforms - Finite Fourier Sine Transform - Finite Fourier Cosine Transform - Inversion formula for sine and cosine transforms only - statement and related problems.

Activities

Seminar/ Quiz/ Assignments/Applications of Integral Transforms in real life problems /Problem Solving Sessions.

Text Book

B.S. Grewal, Higher Engineering Mathematics, Khanna Publishers, 44th Edition, 2017.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Book

1. Fourier Series and Integral Transformations by Dr.S. Sreenadh and others, published by S.Chand and Co, New Delhi

2. E.M. Stein and R. Shakarchi, Fourier analysis: An introduction, (Princeton University Press, 2003).

3. R.S. Strichartz, A guide to Distribution theory and Fourier transforms, (World scientific, 2003).

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 11: INTEGRAL TRANSFORMS WITH APPLICATIONS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Application of Laplace Transform to solutions of Differential Equations	2	2	24
II	Application of Laplace Transform to solutions of Differential Equations	2	2	24
III	Application of Laplace Transforms to Integral Equations	1	2	22
IV	Fourier Transforms - I	2	2	24
V	Fourier Transforms - II	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MAHARAJAH'S COLLEGE AUTONOMOUS ::VIZIANAGARAM

B.Sc (HONS) MATHEMATICS MAJOR

SECOND B.Sc FOURTH SEMESTER MODEL PAPER

PAPER 11 INTEGRAL TRANSFORMS WITH APPLICATIONS

TIME : 3hours MAX MARKS: 60

SECTION – A

Answer any five of the following.

Each question carries 2 marks 5x2=10

1. Solve $(D^2 - 2D + 2)y = 0, y = Dy = 1 \; when \; t = 0$ by using laplace transforms

2. Apply Laplace transform to solve $\frac{d^2y}{dt^2} + y = 6\cos 2t$, if y=3 ,Dy=1 when t=0

3. If y(x,t) is a function of x and t , prove that

(i) $L\left\{\frac{\partial y}{\partial t}\right\} = p\overline{y}(x,t) - y(x,0)$

(ii) $L\left\{\frac{\partial y}{\partial x}\right\} = \frac{\partial}{\partial x}\overline{y}$

4. Solve the equation $F'(t)\sin t + \int_0^t F(t-u)\cos u \; du$, for F(t) with the condition that F(0)=0

5. If $\overline{f}(p)$ is the complex Fourier transform of f(x) then prove that

$$F[f(x-a)] = e^{iap}\overline{f}(p)$$

6. Solve $f(x) = \begin{cases} 1, & |x| < a \\ 0, & |x| > a \end{cases}$ and $\overline{f}(p)$=2$\frac{\sin pa}{p}$,(P≠0) then prove that $\int_0^\infty \frac{\sin^2 ax}{x^2} = \frac{\pi a}{2}$

7. Convert $y''(t) - 3y'(t) + 2y(t) = 4\sin t \;, y(0) = 1, y'(0) = -2$ into integral equation.

8. Define Fourier sine transform and Fourier cosine transform

SECTION-B

Answer any five of the following.

Each question carries 10 marks 5x10=50

9. (a)Solve the differential equation $\frac{d^2y}{dt^2} + 2\frac{dy}{dt} + 5y = e^t \sin t$

$when \; y(0) = 0, y'(0) = 1$by using Laplace Transform.

OR

(b)Solve $ty'' + 2y' - ty = 0, if \; y(0) = 1, y(\pi) = 0$

10. (a)Solve the equations $\frac{dx}{dt} + y = \sin t, \frac{dy}{dt} + x = \cos t$, given that x=2 and y=0 at t=0

OR

(b)Solve$\frac{\partial^2 y}{\partial x^2} - \frac{\partial^2 y}{\partial t^2} = xt when\ y = 0 = \frac{\partial y}{\partial x}\ at t = 0\ and\ y(0,t) = 0$

11. (a)Solve the integral equation $\int_0^t \frac{F(u)}{(t-u)^{1/3}} du = t(1+t)$

OR

(b)Convert the integral equation $F(u) - \int_0^t (t-u) \sec t F(u) du = t$ into differential equation and associated conditions.

12. (a)Find the Fourier sine transform of$\frac{e^{-ax}}{x}$ and deduce that

$$\int_0^\infty \frac{e^{-ax} - e^{-bx}}{x} \sin px\, dx = \tan^{-1}\left(\frac{p}{a}\right) - \tan^{-1}\left(\frac{p}{b}\right)$$

OR

(b)Use the sine inversion formula to obtain f(x) if $\overline{f_s}(p) = \frac{p}{(1+p^2)}$

13. (a) Solve the integral equation

$$\int_0^\infty F(x) \cos px\, dx = \begin{cases} 1 - p, if\ 0 \le p < 1 \\ 0, if\ p > 1 \end{cases} .$$

Hence deduce that $\int_0^\infty \frac{\sin^2 t}{t^2} dt = \frac{\pi}{2}$

(b) (i)Find the finite cosine transform of f(x),if f(x)=sin $x$in $(0,\pi)$

(ii)Evaluate$\int_0^\infty \left(\frac{\sin x - x\cos x}{x^3}\right) dx$ by using Parseval's identity.

SEMESTER-IV

COURSE -iv: INTRODUCTION TO REAL ANALYSIS (Minor)

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Get clear idea about the real numbers and real valued functions.

CO2. Obtain the skills of analyzing the concepts and applying appropriate methods fortesting convergence of a sequence/ series.

CO3. Test the continuity and differentiability and Riemann integration of a function.

CO4. Know the geometrical interpretation of mean value theorems.

CO5. Know about the fundamental theorem of integral calculus.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Contents

Unit – 1

REALNUMBERS, REAL SEQUENCES

The algebraic and order properties of R - Absolute value and Real line - Completeness property of R - Applications of supremum property - intervals. (**No question is to be set from this portion)** Sequences and their limits -Range and Boundedness of Sequences - Limit of a sequence and Convergent sequence -The Cauchy’s criterion - properly divergent sequences - Monotone sequences - Necessary and Sufficient condition for Convergence of Monotone Sequence - Limit Point of Sequence -Subsequences and the Bolzano-weierstras’s theorem – Cauchy Sequences – Cauchy’s general principle of convergence.

Unit – 2

INFINITIE SERIES

Introduction to series –convergence of series -Cauchy’s general principle of convergence for series tests for convergence of series - Series of non-negative terms - P-test - Cauchy’s nth root test -D’-Alembert’s Test-Alternating Series–Leibnitz Test.

Unit –3

LIMIT & CONTINUITY

Real valued Functions – Bounded ness of a function - Limits of functions - Some extensions of the limit concept - Infinite Limits - Limits at infinity **(No question is to be set from this portion).**Continuous functions - Combinations of continuous functions - Continuous Functions on intervals - uniform continuity.

Unit – 4

DIFFERENTIATION AND MEAN VALUE THEOREMS

The derivability of a function at a point and on an interval - Derivability and continuity of a function –Mean value Theorems -Rolle’sTheorem, Lagrange’s Theorem, Cauchy’s Mean value Theorem

Unit – 5
RIEMANN INTEGRATION

Riemann Integral - Riemann integral functions - Darboux theorem -Necessary and sufficient condition for R integrability - Properties of integrable functions - Fundamental theorem of integral calculus - integral as the limit of a sum - Mean value Theorems.

Activities

Seminar/ Quiz/ Assignments/ Applications of Real Analysis to Real life Problem /Problem Solving Sessions.

TextBook

An Introduction to Real Analysis by Robert G.Bartle and Donlad R. Sherbert, John Wiley and sonsPvt. Ltd

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

ReferenceBooks

1. ElementsofRealAnalysis by ShanthiNarayan andDr.M.D.Raisinghania, S. Chand & Company Pvt. Ltd., New Delhi.

2. Principles of Mathematical Analysis by Walter Rudin, McGraw-Hill Ltd.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 10: INTRODUCTION TO REAL ANALYSIS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	REALNUMBERS, REAL SEQUENCES	2	2	24
II	INFINITIE SERIES	2	2	24
III	LIMIT & CONTINUITY	1	2	22
IV	DIFFERENTIATION AND MEAN VALUE THEOREMS	2	2	24
V	RIEMANN INTEGRATION	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MAHARAJH'S COLLEGE (AUTONOMOUS):: VIZIANAGARAM-2

2^{nd} B.SC., FOURTH SEMESTER EXAMINATIONS

MODEL PAPER (2023-27BATCH)

MATHEMATICS Minor

Subject: **Real Analysis, Course-4**

Time: 2 ½ Hours   Max. Marks: 60M

Section – A

1. Answer any **FIVE** questions. Each question carries **TWO** marks.   5 X 2 = 10M

a) Prove that every convergent sequence is cauchy.

b) Define monotone sequence give example.

c) Test for convergent $\sum \frac{2^n}{n^3}$

d) Define alternating series give example.

e) Let f be defined by $f(x) = \frac{(x^2+x-6)}{(x-2)}$ for $x \in R\backslash\{2\}$. Can f be defined at $x = 2$ in such a way that f is continuous at this point?

f) Define continuity of a function at a given point

g) Show that $f(x) = x \sin\left(\frac{1}{x}\right), x \neq 0, x = 0$ is continuous but not derivable at x=0.

h) If $f(x) = x^2 \; on \; [0,1] \;\; and \;\; p = \{0, \frac{1}{4}, \frac{2}{4}, \frac{3}{4}, \ldots \ldots\}$ compute L(p, f) and U(p,f)

Section – B

Answer **AL**L following questions. Each question carries **TEN** marks.

(5 X 10 = 50M)

2.a) Prove that a **Monotone sequence** is convergent if and only if it is bounded.

(OR)

b) State and Prove that **sandwich theorem** of sequences.

3. a) State and prove Leibnitz test

(**OR)**

b) Test for convergence

$$a) \sum_{n=1}^{\infty} \left(\sqrt{n^3+1} - \sqrt{n^3}\right) \qquad b) \sum_{n=1}^{\infty} (\sqrt{n^4+1} - \sqrt{n^4-1}$$

4. a) Examine for continuity the function f define by $f(x) = |x| + |x-1| \ at \ x = 0, 1.$

(OR)

b) If $f: I = [a, b] \rightarrow R$ is continuous on [a, b], then prove that f is uniformly continuous

5. a) Show that $\frac{v-u}{1+v^2} < Tan^{-1}v \, . Tan^{-1}u < \frac{v-u}{1+u^2}$ for 0<u<v. Hence deduce that $\frac{\pi}{4} + \frac{3}{25} < Tan^{-1}\frac{4}{3} < \frac{\pi}{4} + \frac{1}{6}$

(OR)

b) State and prove Rolle's theorem.

6. a) Prove that $f(x) = x^2$ is integrable on [0,a] and $\int_0^a x^2 dx = \frac{a^3}{3}$

(OR)

b) State and prove fundamental theorem of integral calculus

SEMESTER-IV
COURSE -iii: RING THEORY (Minor)

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Acquire the basic knowledge of rings, fields and integral domains

CO2. Get the knowledge of subrings and ideals

CO3. Construct composition tables for finite quotient rings

CO4. Study the homomorphisms and isomorphisms with applications.

CO5. Get the idea of division algorithm of polynomials over a field.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit – 1

Rings and Fields

Definition of a ring and Examples –Basic properties – Boolean rings - Fields – Divisors of 0 and Cancellation Laws– Integral Domains – Division ring - The Characteristic of a Ring, Integral domain and Field – Non Commutative Rings - Matrices over a field – The Quaternion ring.

Unit – 2

Sub rings and Ideals

Definition and examples of Sub rings – Necessary and sufficient conditions for a subset to be a sub ring – Algebra of Sub rings – Centre of a ring – left, right and two sided ideals – Algebra of ideals – Equivalence of a field and a commutative ring without proper ideals

Unit -3

Principal ideals and Quotient rings

Definition of a Principal ideal ring (Domain) – Every field is a PID – The ring of integers is a PID – Example of a ring which is not a PIR – Cosets – Algebra of cosets – Quotient rings – Construction of composition tables for finite quotient rings of the ring Z of integers and the ring $Zn$of integers modulo n.

Unit – 4

Homomorphism of Rings

Homomorphism of Rings – Definition and Elementary properties – Kernel of a homomorphism – Isomorphism – Fundamental theorems of homomorphism of rings – Maximal and prime Ideals – Prime Fields

Unit – 5

Rings of Polynomials

Polynomials in an indeterminate – The Evaluation morphism -- The Division Algorithm in $F[x]$ – Irreducible Polynomials – Ideal Structure in $F[x]$ – Uniqueness of Factorization $F[x]$.

Activities
Seminar/ Quiz/ Assignments/ Applications of ring theory concepts to Real life Problem /Problem Solving Sessions.

Text book
Modern Algebra by A.R.Vasishta and A.K.Vasishta, Krishna Prakashan Media Pvt. Ltd.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference books

1. A First Course in Abstract Algebra by John. B. Farleigh, Narosa Publishing House.
2. Linear Algebra by Stephen. H. Friedberg and Others,Pearson Education India.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 9: RING THEORY(MAJOR)				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Rings and Fields	2	2	24
II	Sub rings and Ideals	2	2	24
III	Principal ideals and Quotient rings	1	2	22
IV	Homomorphism of Rings	2	2	24
V	Rings of Polynomials	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MAHARAJAH'S COLLEGE (AUTONOMOUS)

Ring Theory Model Paper (Minor)

SECTION-A

1.Answer any FIVE from the following questions: 5X2 = 10M

1. Define Boolean Ring.
2. If R is a Boolean Ring then a+a = 0 ∀ a∈R.
3. Define Subring.
4. Define Ideal.
5. Define Quotient Ring.
6. Define Maximal Ideal.
7. Define Kernal of Homomorphism.
8. Define Irreducible Polynomial.

SECTION-B

Answer ALL the following questions: 5X10 = 50M

2. a) Prove that a finite integral domain is a field.

(OR)

b) Prove that Q($\sqrt{2}$) = {a+b$\sqrt{2}$ / a,b∈R} is a field w.r.t. addition and multiplication of numbers.

3. a) Show that Union of two subrings is a subring of R if and only if one is contained other.

(OR)

b) Prove that a commutative ring R with unity element is a field if R have no proper ideals.

4. a) Show that Ring of integers is a Principal ideal ring.

(OR)

b) If $\frac{R}{U}$ is the Quotient Ring Prove that i) $\frac{R}{U}$ is commutative if R is commutative and

ii) $\frac{R}{U}$ has unity element if R has unity element

5. a) State and prove that Fundamental theorem of Homomorphism of rings.

(OR)

b) Prove that an ideal U of a commutative ring R with unity is maximal if and only if the quotient of ring $\frac{R}{U}$ is a field.

6. a) State and Prove that Division algorithm.

(OR)

b) If F[x] is a set of all polynomials over a field F then every ideal in F[x] is a Principal deal.

SEMESTER-V

COURSE 12: LINEAR ALGEBRA

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Understand the concepts of vector spaces, subspaces

CO2. Understand the concepts of basis, dimension and their properties

CO3. Understand the concept of linear transformation and its properties

CO4. Apply Cayley- Hamilton theorem to problems for finding the inverse of a matrix and higher powers of matrices without using routine methods

CO5. Learn the properties of inner product spaces and determine orthogonality in inner product spaces.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

UNIT – I

Vector Spaces-I

Vector Spaces - General properties of vector spaces - n-dimensional Vectors - addition and scalar multiplication of Vectors - internal and external composition - Null space - Vector subspaces -Algebra of subspaces - Linear Sum of two subspaces - linear combination of Vectors- Linear span Linear independence and Linear dependence of Vectors.

UNIT –II

Vector Spaces-II

Basis of Vector space - Finite dimensional Vector spaces - basis extension - co-ordinates- Dimension of a Vector space - Dimension of a subspace - Quotient space and Dimension of Quotient space.

UNIT –III

Linear Transformations

Linear transformations - linear operators- Properties of L.T- sum and product of L.Ts - Algebra of Linear Operators - Range and null space of linear transformation - Rank and Nullity of linear transformations - Rank- Nullity Theorem.

UNIT –IV

Matrices

Characteristic equation - Characteristic Values - Characteristic vectors of a square matrix - Cayley Hamilton Theorem – problem on Cayley Hamilton Theorem.

UNIT –V

Inner product space

Inner product spaces- Euclidean and unitary spaces- Norm or length of a Vector- Schwartz inequality- Triangle Inequality- Parallelogram law- Orthogonality- Orthonormal set- Problems on Gram– Schmidt orthogonalisation process - Bessel’s inequality.

Activities :

Seminar/ Quiz/ Assignments/Applications of Linear Algebra in real life problems\ Problem Solving.

Text Books

1. Linear Algebra by J.N. Sharma and A.R. Vasishtha, published by Krishna Prakashan Media (P) Ltd.
2. Matrices by A.R.Vasishtha and A.K.Vasishtha published by Krishna Prakashan Media (P) Ltd.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Linear Algebra by Stephen H. Friedberg et. al. published by Prentice Hall of India Pvt. Ltd. 4th Edition, 2007
2. Linear Algebra by Kenneth Hoffman and Ray Kunze, published by Pearson education low priced edition), New Delhi.
3. Matrices by Shanti Narayana, published by S.Chand Publications.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 12: LINEAR ALGEBRA				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Vector Spaces-I	2	2	24
II	Vector Spaces-II	2	2	24
III	Linear Transformations	1	2	22
IV	Matrices	2	2	24
V	Inner product space	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Paper – XII: Linear Algebra

Time: 2 ½ Hours **Max. Marks: 60M**

Section – A

1.Answer any **FIVE** questions, each question carries **TWO** marks. 5 X 2 = 10M

a) Prove that the intersection of any two subspaces w_1 and w_2 of vector space V(F) is also a subspace.

b) Show that the system of vectors $(1,3,2),(1,-7,-8),(2,1,-1)$ of $v_3(R)$ is linearly dependent.

c) Show that $(2,2,1),(2,1,1),(2,1,0)$ from a basis of $(1,2,1)$ in $v_3(R)$.

d) Let w_1 and w_2 be two subspaces of R^4 given by $w_1=\{(a,b,c,d): b-2c+d=0\}$, $w_2=\{(a,b,c,d): a=d, b=2c\}$ find the basis and dimension of w_1.

e) Define linear transformation.

f) Let $T: v_3(R) \to v_2(R)$ and $H: v_3(R) \to v_2(R)$ be the two linear transformations defined by $T(x,y,z)=(x-y,y+z)$ and $H(x,y,z)=(2x,y-z)$ $find$ $i)\ H+T$ $ii)\ a+H$

g) Define characteristic vector of a square matrix.

h) State and prove Triangle inequity.

Section – B

Answer **ALL** following questions. Each question carries **TEN** marks. (5 X 10 = 50M)

2. A) Let V(T) be a vector space a non-empty set $w \leq v$. The necessary and sufficient conditions for w to be a subspace of v is a $a,b \in F$ and $\alpha,\beta \in V \Rightarrow a\alpha + b\beta \in W$.

(OR)

B) Let V(F) be a vector space and $s=\{\alpha_1,\alpha_2,\alpha_3,\ldots..\alpha_n\}$ is a finite subset of non-zero vector of V(F) then s is linearly dependent if and only if some vector $\alpha_k \in s, 2 \leq k \leq n$ can be expressed as a linear combination of its preceding vectors.

3. A) Let $w_1 and$ w_2 be two subspaces of a finite dimensional vector space V(F). Then $\dim(w_1+w_2)=dimw_1+dimw_2-\dim(w_1 \cap w_2)$

(OR)

B) Let w be a subspace of a finite dimensional vector space V(F), then $\dim\left(\frac{v}{w}\right)=\dim v-\dim w$

4. A) Find T(x,y,z) where $T: R^3 \to R$ is defined by $T(1,1,1)=3$,$T(0,1,-2)=1$,$T(0,0,1)=-2$.

(OR)

B) State and prove Rank-Nullity Theorem.

5. A) Find the characteristic roots and the corresponding characteristic vectors of the matrix

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

(OR)

B) State and prove Cayley-Hamilton Theorem.

6. A) If α,β are two vectros in an inner product space then α,β are linearly dependent if and only if $|\langle\alpha,\beta\rangle| = ||\alpha||\ ||\beta||$

(OR)

B) Given $\{(2,1,3),(1,2,3),(1,1,1,)\}$ is a basis of R^3 construct on orthonormal basis.

SEMESTER-V

COURSE 13: VECTOR CALCULUS

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Learn multiple integrals as a natural extension of definite integral to a function of two variables in the case of double integral/three variables in the case of triple integral.

CO2. Learn applications in terms of finding surface area by double integral and volume by triple integral.

CO3. Determine the gradient, divergence and curl of a vector and vector identities.

CO4. Evaluate line, surface and volume integrals.

CO5. Understand relation between surface and volume integrals (Gauss divergence theorem), relation between line integral and volume integral (Green's theorem), relation between line and surface integral (Stokes theorem).

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

Unit–1

Multiple Integrals-I

Introduction –Double integrals –Evaluation of double integrals –Properties of double integrals – Region of integration –double integration in Polar Co-ordinates – Change of variables in double integrals – change of order of integration.

Unit–2

Multiple integrals-II

Triple integral –region of integration –change of variables -Plane areas by double integrals –surface area by double integral –Volume as a double integral, volume as a triple integral.

Unit–3

Vector differentiation

Vector differentiation –ordinary – derivatives of vectors – Differentiability –Gradient –Divergence –Curl operators – Formulae involving these operators.

Unit–4

Vector integration

Line Integrals with examples - Surface Integral with examples – Volume integral with examples.

Unit–5

Vector integration applications

Gauss theorem and applications of Gauss theorem - Green's theorem in plane and applications of Green's theorem - Stokes's theorem and applications of Stokes theorem.

Activities

Seminar/ Quiz/ Assignments/ Applications of Vector calculus to Real life Problems /Problem Solving Sessions.

Text Book
A text Book of Higher Engineering Mathematics by B.S.Grawal, Khanna Publishers, 43rd Edition

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

ReferenceBooks
1. Vector Calculus by P.C.Matthews, Springer Verlag publications.
2. Vector Analysis by Murray Spiegel, Schaum Publishing Company, NewYork .

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 13: VECTOR CALCULUS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Multiple Integrals-I	2	2	24
II	Multiple Integrals-II	2	2	24
III	Vector differentiation	1	2	22
IV	Vector integration	2	2	24
V	Vector integration applications	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MULTIPLE INTEGRAL AND VECTOR CALCULUS MODEL PAPER

Time:3Hrs. **Max.Marks: 60M**

PART-A

I. Answer any 5(FIVE)of the following : 5X2=10M

A. Evaluate $\int_0^1 \int_x^{\sqrt{x}} (x^2 + y^2) dx\, dy$.

B. Evaluate $\int \int r \sqrt{a^2 - r^2}$ dθ dr over the upper half of the circle r = a cosθ

C. Evaluate $\int_0^1 \int_0^{1-x} \int_0^{1-x-y} \frac{dxdydz}{(x+y+z+1)^3}$.

D. Find the area of a loop of the curve r = a sin3θ

E. If r = a cost i + a sin t j + a t tanθ k . find $\left|\frac{dr}{dt} \times \frac{d^2r}{dt^2}\right|$

F. if a = x+y+z, b = $x^2+y^2+z^2$, z = xy+yz+xz. Prove that [grad a , grad b , grad c] = 0

G. if f(t) = $5t^2$ I + t j + t^3k. find $\int_1^2 (f \times \frac{d^2f}{dt^2})$dt.

H. Show that $\int_s (axi + byj + czk).Nds = \frac{4\pi}{3}(a + b + c)$ where S is the surface of the Sphere $x^2+y^2+z^2 = 1$

PART-B

II. Answer <u>ALL</u> the following Questions: 5X10=50M

2. a) By changing into polar co-ordinates Evaluate $\int \int \frac{x^2y^2}{x^2+y^2}$ dx dy over the angular region between the circles $x^2+y^2 = a^2$, $x^2+y^2 = b^2$ (b > a)

(Or)

b) Change the order of integration and evaluate $\int_0^a \int_{\frac{x^2}{a}}^{2a-x} xy\, dx\, dy$.

3. a) Find the Volume of the Eclipsed $\frac{X^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1$ by using double integral

(Or)

b) Find the Volume of the Portion of the Sphere $x^2+y^2+z^2 = a^2$ lying inside the cylinder $x^2+y^2 = ax$

4. a) if a is a constant Vector. Prove that Curl $\frac{a\times r}{r^3} = \frac{-a}{r^3} + \frac{3r}{r^5}(a.r)$

(Or)

b) Prove that Curl (A × B) = A div B – B div A + (B.V) A – (A.V)B

5. a) If F = 4xzi – y^2j + yzk, Evaluate $\int F.Nds$ where S is the surface of the cube bounded by x=0.x=a, y=0.y=a, z=0.z=a.

(Or)

b) If F = 2xzi –xj + y^2k, Evaluate $\int_v f.dv$ where V is the region bounded by the surface x=0.x=2, y=0.y=6, z=x^2.z=4.

6. a) State and prove Gauss Divergence Theorem.

(Or)

b) State and Prove Stokes Theorem.

SEMESTER-V
COURSE 14: ADVANCED NUMERICAL METHODS

Course Outcomes

After successful completion of this course, the student will be able to

CO1. Find derivatives using various difference formulae

CO2. Understand the process of Numerical Integration

CO3. Solve Simultaneous Linear systems of Equations

CO4. Understand Iterative methods

CO5. Find Numerical Solution of Ordinary Differential Equations

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content
UNIT – I
Numerical Differentiation

Derivatives using Newton's forward difference formula - Newton's backward difference formula-Derivatives using central difference formula - Stirling's interpolation formula - Newton's divided difference formula.

UNIT – II
Numerical Integration

General quadrature formula on errors - Trapezoidal rule – Simpson's 1/3 rule - Simpson's 3/8 rule-Weddle's rule - Euler-Maclaurin formula of summation and quadrature - The Euler transformation.

UNIT – III
Solution of Simultaneous Linear systems of Equations – I

Solution of linear systems - Direct Methods - Matrix inversion method – Gaussian elimination method-Gauss Jordan Method.

UNIT – IV
Solution of Simultaneous Linear systems of Equations – II

Method of factorization - solution of Tridiagonal systems - Iterative methods - Jacobi's method - Gauss - Siedal method.

UNIT – V
Numerical Solution of Ordinary Differential Equations

Introduction – solution of Taylor's series – Picard's method of successive approximations – Euler's method – Modified Euler's method – Runge-Kutta methods.

Activities

Seminar/ Quiz/ Assignments/ Applications of Numerical methods to Real life Problem /Problem Solving Sessions.

Text Book

Numerical Analysis by G. Shanker Rao, New Age International Publications

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Applied Numerical Analysis by Curtis F. Gerald and Patrick O. Wheatley, Pearson Publications.
2. Numerical Methods for Scientific and Engineering Computation by M. K. Jain, S .R. K. Iyengar and R. K. Jain,
New Age International Publishers.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 14: ADVANCED NUMERICAL METHODS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Numerical Differentiation	2	2	24
II	Numerical Integration	2	2	24
III	Solution of Simultaneous Linear systems of Equations – I	1	2	22
IV	Solution of Simultaneous Linear systems of Equations – II	2	2	24
V	Numerical Solution of Ordinary Differential Equations	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

Maharajah's College (Autonomous), Vizianagaram

Affiliated to Andhra University, Accredited by NAAC with B grade

Listed U/S 2(f) and 12(B) of the UGC Act 1956

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14. ADVANCED NUMERICAL METHODS

MODEL QUESTION PAPER

PART A

Answer any 5 question from the following: **5x2=10 Marks**

1 Write the errors in Numerical Differentiation?

2 Using the following table compute dy/dx and d^2y/dx^2 at x=1

x	1	2	3	4	5	6
y	1	8	27	64	125	216

3 State the Weddle's rule ?

4 State the Euler Maclaurin's summation formula ?

5 Explain Matrix inversion method

6 Solve the system of equtions by Jacobi's iteration method 14x-3y =8;x+5y =11.

7 Show that the system of equations 2x+y=2;2x+ 1.01y = 2.01 is ill conditioned.

8 Given y ' = x^2 -y , y (0) =1 find correct to four decimal places the value of y (0.1) by using Euler's method .

PART B

Answer any 5 question from the following: **5x10=50 Marks**

9(a) Using Newton's dividend difference formula find f '(0) ,f '(6) and ∫ f(x) dx at 0 to 9

x	0	2	3	4	7	9
f (x)	4	26	58	112	466	922

OR

9(b) Using Strirling formula to find f '(1.22) from the following table

x	1	1.1	1.2	1.3	1.4
f (x)	2	12	36	56	94

10(a) State and prove that general quadrature formula for equidistinct ordinates ?

OR

10(b) Find the value of the integral ∫ 1 / (1 + x^2) dx, dx from 0 to 1 by using simpson's 1/3 and 3/8 rule. hence obtain the approximate value of π in each cases.

11(a) Using Gauss - Jordan Method Solve the system 2x + y + z = 10; 3x +2y + 3z =18; x +4y + 9z =16

OR

11(b) Solve the equations 2x +y+z =10; 3x +2y+3z =18;x+4y+9z =16 by using Gauss - Elimination method ?

12(a) Solve the equations 2x +3y +z =9; x+2y +3z =6; 3x +y+2z =8 by factorization method ?

OR

12(b) Solve the system of the equations by Gauss -Seidel Method 83x +11y- 4z =95;7x+52y+13z =104;3x +8y+29z =71

13(a) Use Picards method to solve the initial value problem dy/dx = 1+xy and y(0) =1 and compute y (0.1) correct to four decimals places.

OR

13(b) Using Runge- Kutta method find y(0.4) for the equation dy /dx = (y-x) /(y +x) , y(0) = 1 taken as h = 0.2

SEMESTER-V

COURSE 15: NUMBER THEORY

Course Outcomes

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

CO1. Understand the fundamental theorem of arithmetic

CO2. Understand Mobius function, Euler quotient function, The Mangoldt function, Liouville's function, the divisor functions and the generalized convolutions.

CO3. Understand Euler's summation formula, application to the distribution of lattice points and the applications to μ (n) and Λ (n)

CO4. Understand the concepts of congruencies, residue classes and complete residues systems.

CO5. Comprehend the concept of quadratic residues mod p and quadratic non residues mod p.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

UNIT-I

The Fundament Theorem of Arithmetic

Introduction, Divisibility, Greatest common divisor, Prime numbers, The fundamental theorem of arithmetic, The series of reciprocals of the primes, The Euclidean algorithm, The greatest common divisor of more than two numbers

UNIT-II

Arithmetical Functions and Dirichlet Multiplication

Introduction- The Mobius function $\mu\ (n)$ – The Euler quotient function $\varphi\ (n)$ - A relation connecting φ and μ - A product formula for $\varphi\ (n)$ - The Dirichlet product of arithmetical functions- Dirichlet inverses and the Mobius inversion formula- The Mangoldt function $\Lambda\ (n)$- multiplicative functions- multiplicative functions and Dirichlet multiplication- The inverse of a completely multiplicative function-Liouville's function $\lambda\ (n)$ - The divisor functions $\sigma_\alpha\ (n)$

UNIT-III

Averages of Arithmetical Functions

Introduction- The big oh notation. Asymptotic equality of functions- Euler's summation formula- Some elementary asymptotic formulas-The average order of $d(n)$- The average order of the divisor functions $\sigma_\alpha\ (n)$- The average order of $\varphi\ (n)$- An application to the distribution of lattice points visible from the origin- The average order of $\mu\ (n)$ and $\Lambda(n)$-The partial sums of a Dirichlet product- Applications to μ (n) and $\Lambda\ (n)$

UNIT-IV

Congruences

Definition and basic properties of congruence's- Residue classes and complete residue systems- Linear congruences- Reduced residue systems and the Euler- Fermat theorem- Polynomial congruences modulo p. Lagrange's theorem- Applications of Lagrange's theorem- Simultaneous linear congruences. The Chinese remainder theorem- Applications of the Chinese remainder theorem

UNIT-V

Quadratic Residues and the Quadratic Reciprocity Law

Quadratic Residues, Legendre's symbol and its properties, Evaluation of $(-1/p)$ and $(2/p)$, Gauss lemma, The Quadratic reciprocity law, Applications of the reciprocity law, The Jacobi Symbol, Gauss sums and the quadratic reciprocity law, the reciprocity law for quadratic Gauss sums, Another proof of the quadratic reciprocity law.

Activities

Seminar/ Quiz/ Assignments/ Applications of Number theory to Real life Problem /Problem Solving Sessions

Text Book

Introduction to Analytic Number Theory by T.M.Apostol, Springer Verlag-New York, Heidalberg-Berlin-1976.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Elementary Number Theory by G.A.Jones and J.M.Jones, , Springer
2. Elementary Number Theory by David, M. Burton, 2nd Edition UBS Publishers.
3. Number Theory by Hardy & Wright, Oxford Univ., Press.
4. Elements of the Theory of Numbers by Dence, J. B &Dence T.P, Academic Press

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 15: NUMBER THEORY				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	The Fundament Theorem of Arithmetic	2	2	24
II	Arithmetical Functions and Dirichlet Multiplication	2	2	24
III	Averages of Arithmetical Functions	1	2	22
IV	Congruences	2	2	24
V	Quadratic Residues and the Quadratic Reciprocity Law	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

15A. NUMBER THEORY
MODEL QUESTION PAPER
PART A

1.Answer any 5 question from the following:	5x2=10 Marks

A. If a/bc and (a,b) = 1 then prove that a/c.

B. If (a,b)=1 then prove that (a+b,a-b) is either 1 or 2.

C. Prove that φ(mn) = φ(m)φ(n) if (m,n) =1.

D. Define Liouville's function and Divisor function with examples.

E. prove that for all x≥1, ∑n≤xσ(n)=12ζ(2)x2+O(xlogx)

F. Show that the linear congruence 2x≅3(mod 4) has no solution.

G. state the lagrange's theorem on congruences

H. Evaluate values of (-1/p) and (2/p)

PART B

Answer any 5 question from the following:	5x10=50 Marks

2.a State and prove that Fundamental theorem of Arithmetic.

OR

2.b state and prove that the Euclidean division algorithm.

3.a Find the relation between Mobius function and Euler totient function

OR

3.b Define Mangoldt function Λ(n) and if n≥ 1then prove that Λ(n)=∑d|nμ(d)log(n/d)

4.a state and prove that Euler's summation formula?

OR

4.b state and prove that Legendre's identity

5.a State and prove Chinese remainder theorem and use it to find the least positive integer that give remainder 1, 2, 3 when divided by 3, 4, 5 respectively

OR

5.b If (a,n) =1 then prove that aϕ(n)≡1(mod n)

6.a State and prove Quadratic Reciprocity Law and find the value of (17/19)

OR

6.b Apply both Jacobi's and Legendre symbol to determine whether the following congruences have a solution
(i) x^2 = 135 (mod 173) (ii) x^2 = 21(mod 253)

SEMESTER-VII
COURSE 16: ALGEBRA

Course Outcomes
After successful completion of the course, students will be able to
CO1. Understand the direct product of groups and application of Sylow's theorems
CO2. Understand the homomorphic relation between the groups, sum and direct sum of ideals
CO3. Know factorizing the domains and factorization of polynomials
CO4. Know about sub modules and direct sums
CO5. About Free modules and Representation of linear mappings

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content
UNIT-I
Structure theorems of groups
Direct products-Finitely generated abelian groups-Invariants of finite abelian group-Sylow theorems. (Sections 8.1 to 8.4 of the Chapter 8 in the Prescribed Text Book.)

UNIT-II
Ideals and Homomorphisms
Ideals-Homomorphisms-Sums and direct sums of ideals- Maximal and prime ideals-Nilpotent and nil ideals-Zorn's lemma. (Sections 10.1 to10.6 of the Chapter 10 in the Prescribed Text Book.)

UNIT-III
Unique factorization domains and Euclidean domains
Unique factorization domains-Principal ideal domains-Euclidean domains-Polynomial rings over UFD (Sections 11.1 to 11.4 of the Chapter 11 in the Prescribed Text Book.)

UNIT IV
Modules and Vector Spaces
Definition and examples – Submodules and direct sums – R-homomorphisms and quotient modules (Sections 1,2& 3 of Chapter - 14)

UNIT V
Free Modules
Completely reducible modules – Free modules – Representation of linear mappings – Rank of linear mapping (Sections 4 to 7 of Chapter - 14)

Activities
Seminar/ Quiz/ Assignments/ Applications of Algebra to Real life Problem /Problem Solving

Text Book
Basic Abstract Algebra by P.B.Battacharya,S.K.jain, S.R.Nagpaul, Cambridge University Press.

Web Sources

https://swayam.gov.in/explorer?ncCode=CEC

Reference Book

1. Topics in Algebra by I.N.Herstein, 2ndEdition, JohnWiley&Sons
2. Algebra by SergeLang, Revised Third Edition, Springer
3. Algebra by Thomas W.Hungerford, Springer

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 16: ALGEBRA				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Structure theorems of groups	2	2	24
II	Ideals and Homomorphisms	2	2	24
III	Unique factorization domains and Euclidean domains	1	2	22
IV	Modules and Vector Spaces	2	2	24
V	Free Modules	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MODEL QUESTION PAPER

Answer any five of the following **5*2 =10 M**

A. If G is a cyclic group of order mn, where (m,n)=1 then prove that G$\cong H \times K$,where H is a subgroup of order m and K is a subgroup of order n

B. If G be a finite group.and let P be a prime.if p^m divides|G|,then G has a subgroup of order P^m

C. If D is division ring,then R=D_n has no nontrivial ideals

D. In a nonzero commutative ring with unity an ideal M is Maximal if and only if R/M is a field

E. Show that an irreducible element in a commutative principal ideal domain is always prime

F. Show that the ring of Gaussian integers R={$m + n\sqrt{}$-1/m,nϵz}

G. The Submodules of the quotient module M/N are of the form U/N,where U is a sumodule of M containing N

H. State and prove Schur$'s$ lemma

Answer all of the following **5 * 10 = 50 M**

2(a). State and prove Fundamental theorem of finite generated abelian groups

(OR)

(b). State and prove second and third sylow theorem

3(a).i) If R is a ring with unity ,then each maximal ideal is prime but the converse in general is not true

ii).If R is a commutative ring ,then an ideal P in R is prime If and only if ab$\in P; a \in R, b \in R \Rightarrow a \in P$ or $b \in P$

(OR)

(b).i).State the zorn$'s$ lemma

ii).If R is a nonzero ring with unity 1,and **I** is an ideal in R such that I≠R,then there exist a maximal ideal M of R such that I⊆M

4(a).Show that every PID is a UFD

(OR)

(b).Show that every Euclidean domain is a PID

5(a).If (N_i);1$\leq i \leq k$ is a family of R-submodules of a module M then $\sum_{i=1}^{k} N_i$={x_1+…….+x_k/$x_i \epsilon N_i$}

(OR)

(b).If A and B be R-submodules of R-modules M and N respectively then $\frac{M\times N}{A\times B} \cong \frac{M}{A} \times \frac{N}{B}$

6(a).If M be a finitely generated free module over a commutative ring R.then all bases of M have the same number of elements

(OR)

(b).If $\emptyset: V \to U$ is linear mapping from a vector space V to a vector space U then dim v=dim ker$\emptyset$ +dim Im$\emptyset$

SEMESTER-VII
COURSE 17: DISCRETE MATHEMATICS

Course Outcomes
After successful completion of the course, students will be able to
CO1. To learn the applications of graph theory in other subjects,representations of different problems by means of graphs.
CO2. To learn the relation between bipartite graphs and odd cycles, forest, binary trees, eccentricity of a vertex and radius of connected graphs.
CO3. To learn the multi graphs,hamiltonion graphs,spanning tree, their importance subjects like physics and chemistry.
CO4. To know about posets,lattices, their properties
CO5. To learn different characterizations of modular and distributive lattices.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content
UNIT-I

Basic Ideas, History. Initial Concepts, Summary, Connectivity. Elementary Results, Structure Based. on Connectivity (Chapters 1 & 2 of Text Book 1)

Unit-II

Trees, Characterizations, Theorems on Trees, Tree Distances, Binary trees, Tree Enumeration, Spanning trees, Fundamental Cycles, Summary (Chapter 3 of Text Book 1)

Unit-III

Traversability, Introduction, Eulerian Graphs, Hamiltonian Graphs, Minimal Spanning Trees, J.B.Kruskal's Algorithm, R.C.Prim's Algorithm. (Chapter 4 of Text Book 1 and Section 7.5 of Text Book 2)

Unit-IV

Poset Definition, Properties of Posets, Lattice Definition, Properties of Lattices (Chapter 1-A of Text Book 3)

Unit-V

Definitions of Modular and Distributive Lattices and its Properties (Chapter 1-B of Text Book 3)

Activities

Seminar/ Quiz/ Assignments/ Applications of Discrete Mathematics to Real life Problem /Problem Solving

Text books

1. Graph Theory Applications by L.R. Foulds, Narosa Publishing House, New Delhi.
2. Discrete Mathematical Structures by Kolman and Busby and Sharen Ross, Prentic Hall of India-2000, 3rd Edition
3. Applied Abstract Algebra by Rudolf Lidl and Gunter Pilz. Published by Springer-Verlag.

Reference Book

A text Book of Discrete Mathematics by Harish Mittal, Vinay Kumar Goyal, Deepak Kumar Goyal, IK International Publishing House Pvt.Ltd, New Delhi.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Book
Mathematical Analysisby S C Malik, Savita Arora New age International Publishers

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 17: DISCRETE MATHEMATICS				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Basic Ideas, Connectivity	2	2	24
II	Trees	2	2	24
III	Traversability	1	2	22
IV	Poset	2	2	24
V	Distributive Lattices	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

COURSE 17: DISCRETE MATHEMATICS Model Paper

SECTION –A

ANSWER ANY FIVE FROM THE FOLLOWING QUESTIONS 5X2=10 M

1. (a) Define multigraph
   (b) Define isomorphic graphs give example
   (c) Define Tree and give example
   (d) Define Binary tree
   (e) Define Minimal Spanning Tree
   (f) Show that the the set Z^+ of all positive integers under divisibility relation forms a poset.
   (g) Show that every chain is a Distributive Lattice
   (h) Define Modular Lattice

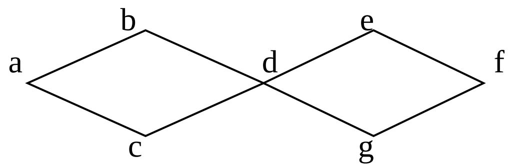
SECTION –B

ANSWER ANY FIVE FROM THE FOLLOWING QUESTIONS 5X10=50 M

2. (i)Prove that the sum of degrees of the vertices in an undirected graph is even.
   (ii)Show that the maximum number of edges in a simple graph with n vertices is $\frac{n(n-1)}{2}$

OR

3. Prove that a Simple graph with n vertices and k components cannot have more than $\frac{(n-k)(n-k+1)}{2}$ edges
4. Use BFS algorithm to find a spanning tree of the graph G given below



OR

5. Prove that for any positive integer n, if G is a connected graph with n vertices and n-1 edges then G is a tree
6. Give an example of Hamiltonian graph but not Eulerian graph and vice-versa

OR

7. Explain Prims algorithm with suitable example.
8. (i)Let X={1,2,3,4,5,6}, then / is a partial order realation on X. Draw the Hasse diagram of $(X, \nmid)$ where $\nmid$ is does not divides

OR

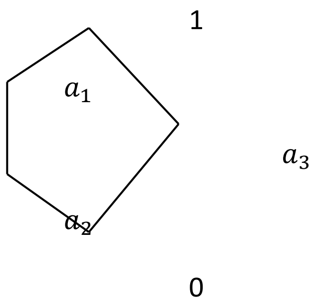
9. Prove the De Morgam laws in the lattice (L,∧,∨)

10. In any Lattice Prove that the distributive inequalities holds

OR

11. (i) Prove that every distributive lattice is modular

(ii)Prove that the lattice given by the following diagram is not modular



SEMESTER-VII

COURSE 18: BASIC TOPOLOGY

Course Outcomes

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

CO1. Handle operations on sets and functions and their properties

CO2. Understand the concepts of Metric spaces, open sets, closed sets, convergence, some important theorems like Cantor's intersection theorem and Baire's theorem

CO3. Familiar with the concept of Topological spaces, continuous functions in more general and characterize continuous functions in terms of open sets, closed sets etc.

CO4. Explain the concept of compactness in topological spaces characterize compactness in metric spaces and their properties.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔				✔			✔		✔		
CO02	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO03	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔		✔				✔			✔		✔		

Course Content

UNIT I

Sets and Functions

Sets and Set inclusion – The algebra of sets – Functions – Products of sets – Partitions and equivalence relations – Countable sets – Uncountable sets – Partially ordered sets and lattices. (Chapter I: Sections 1 to 8 of the prescribed text book).

UNIT-II

Metric spaces

The definition and some examples – Open sets – Closed sets – Convergence, Completeness and Baire'stheorem . (Chapter 2: Sections 9 to 12 of the prescribed text book).

UNIT-III

Metric spaces

Continuous mappings, Spaces of continuous functions – Euclidean and Unitary spaces.(Chapter 2: Sections 13 to15 of the prescribed text book) Topological spaces: The definition and some examples – Elementary concepts– (Chapter 3: Sections 16 to 17 of the prescribed text book).

UNIT-IV

Topological spaces

Open bases and open sub bases, Weak Topologies, The function algebras C(X, R) and C(X, C). (Chapter 3: Sections 18 to 20 of the prescribed text book). Compactness: Compact spaces – Heine – Borel theorem (Chapter 4: Section 21).

UNIT-V

Compactness

Product of Spaces – Tychonoff's theorem and locally Compact spaces – Compactness for metric spaces – Ascoli's theorem. (Chapter 4: Sections 22 to 25 of the prescribed text book).

Activities

Seminar/ Quiz/ Assignments/ Applications of Topology to Real life Problem /Problem Solving .

Text Book
Introduction to Topology and Modern Analysis by G. F. Simmons International Student edition – McGraw – Hill Ltd.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Schaum’s Outlines: General Topology by Seymour Lipschutz
2. Topology: A first Course by James Munkres

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 18: BASIC TOPOLOGY				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Sets and Functions	2	2	24
II	Metric spaces	2	2	24
III	Metric spaces	1	2	22
IV	Topological spaces	2	2	24
V	Compactness	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

COURSE 18: BASIC TOPOLOGY Model Paper

SECTION –A

ANSWER ANY FIVE FROM THE FOLLOWING QUESTIONS 5X2=10M

1. (a) Show that a non empty subset of countable set is countable.
   (b) Define a POSET and give an example.
   (c) In any Metric space X show that each open sphere is an open set.
   (d)Define complete space and give an example
   (e)Define Topological space and give an example
   (f)Define Homeomorphism of Topological spaces
   (g)Define compact space
   (h) State Lebesgue's covering lemma

SECTION –B

ANSWER ANY FIVE FROM THE FOLLOWING QUESTIONS 5X10=50 M

2A).Let A be a non empty subset of a partially ordered set P .Show that A has at most one greatest lowere bound and at most one least upper bound.

OR

2B). Prove that if X_1 and X_2 are countable then X_1 X X_2 is also countable

3A).Let X be a metric space. Then show that (i) any interection of closed sets in X is closed

(ii)any finite union of closed sets in Xis closed

OR

3B).State and prove Baire's theorem

4A). Let X and Y be metric space and f a mapping of X into Y then prove that f is continuous iff

$f^{-1}(G)$ is open in X whenever G is open in Y.

OR

4B).State and prove Cauchy's inequality

5A).State and prove Lindelof's theorem.

OR

5B).State and prove Heine-Borel theorem

6A). State and prove Tychnoff's theorem

OR

6B).State and prove Ascoli's theorem.

SEMESTER-VII

COURSE 19: LATTICE THEORY & BOOLEAN ALGEBRA

Course Outcomes

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

CO1. Understand the concept of partially ordered set and properties of partial ordered sets

CO2. Understand the concept of lattice, semi lattice and their properties

CO3. Understand the concept of ideals and homeomorphisms in lattices

CO4. Understand the distributive and the modular lattices

CO5. Understand the concept of Boolean algebra and properties of Boolean algebra

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔			✔	✔			✔		✔		
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔				✔			✔		✔		

Course Content

UNIT-I

Partly Ordered Sets

Set Theoretical Notations, Relations, partly ordered Sets, Diagrams, special Subsets of a Partly ordered set, length, Lower and Upper Bounds, The minimum and maximum condition.(Chapter 1,section 1 to 8 of the Text Book)

UNIT –II

Lattices in General

Algebras, lattices, The Lattice Theoretical Duality principle, semi Lattices, lattices as Partly ordered sets, Diagrams of lattices, Sub lattices, Ideals, Bound Elements of a lattice, Atoms and Dual Atoms, Complements, Relative Complements, Semi complements, Irreducible Prime Elements of a lattice, The Homomorphism of a lattice (Chapter 2, section 10-20 of the Text Book)

UNIT – III

Complete lattices

Complete lattices, Complete Sub lattices of a complete lattice, Conditionally Complete Lattices, Compact Elements, Compactly Generated lattices, Sub algebra lattice of an Algebra, Closure Operations (Chapter 3, Sections 22-27 of the Text Book)

UNIT – IV

Distributive and Modular Lattices

Distributive lattices, Infinitely Distributive and Completely Distributive lattices, Modular lattices, Characterization of Modular and Distributive lattices by their Sub lattices, Distributive Sub lattices of Modular Lattices, Isomorphism theorems of modular lattice, Meet representation in modular and distributive lattices(Chapter 4 of the Text Book)

UNIT – V

Boolean algebras

Boolean algebras, De Morgan formulae, Complete Boolean algebras, Boolean algebras and Boolean rings, The algebra of relations, The lattice of Propositions, Valuations of Boolean algebras (Chapter 6 of the Text Book)

Activities
Seminar/ Quiz/ Assignments/ Applications of Lattice Theory and Boolean Algebra to Real life Problem /Problem Solving.

Text Book
Introduction to Lattice Theory, Gabor Szasz, Academic press

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Lattice Theory by G. Birkhoff, Amer. Math. Soc.
2. General Lattice Theory by George Grätzer, Birkhäuser Basel (1978)

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 19: LATTICE THEORY & BOOLEAN ALGEBRA				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Partly Ordered Sets	2	2	24
II	Lattices in General	2	2	24
III	Complete lattices	1	2	22
IV	Distributive and Modular Lattices	2	2	24
V	Boolean algebras	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

LATTICE THEORY & BOOLEAN ALGEBRA

Time: 2 ½ Hours Max. Marks: 60M

Section – A

1.Answer any **FIVE** questions, each question carries **TWO** marks. 5 X 2 = 10M

A. Prove that Every Chain is a Lattice Ordered set.
B. Define Zorn's lemma.
C. Define sub lattice.
D. Explain about Hassey diagram of a poset.
E. Prove that the closed elements of L form a complete lattice.
F. Define closed sub lattice.
G. Prove that every chain is distributive.
H. Let B be Boolean algebra then prove that $(a\wedge b)' = a' \vee b'$ for any a , b ∈ B.

Section – B

Answer **ALL** following questions. Each question carries **TEN** marks. 5 X 10 = 50M

2. A) let $(L, \wedge,\vee)$ be a lattice then $(L , \leq)$ is a lattice ordered set which is defined by $x \leq y$ iff $x\wedge y = x \quad \forall\ x, y \in L$

(OR)

B) Prove that in every lattice $(L, \wedge,\vee)$ the operations $\wedge,\vee$ are isotones.

3. A) If $f : L \rightarrow M$ is a lattice homomorphism then f is an order homomorphism but the converse need not be true.

(OR)

B) Prove that any lattice L can be embedded as a sub lattice in the complete lattice L all its ideals.

4. A) Prove that for a lattice L to be conditionally complete , it is sufficient that every bounded non-empty subset of L have infimum and supremum.

(OR)

B) If P is a poset and every subset of P has a sup in P then P is a complete lattice

5. A) A lattice L is modular iff none of its sub lattice is isomorphic to pentagon.

(OR)

B) A lattice L is a distributive iff $x\wedge y = x \wedge z,\ x\vee y = x \vee z \Rightarrow y = z \quad \forall\ x, y, z \in L$

6. A) let B be a finite Boolean algebra and A be the set of all atoms in B then $(B, \wedge,\vee) \cong_b (P(A) , \cap ,\cup)$.

(OR)

B) Prove that B^x is a Boolean algebra.

SEMESTER-VII

COURSE 20: GRAPH THEORY

Course Outcomes

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

CO1.Be familiar with the definitions and basic theory of graphs

CO2. Be able to implement standard algorithms of graph theory

CO3. Be able to prove simple results in graph theory.

CO4. Identify trees and obtains spanning trees of graphs.

CO5. Find Euler and Hamiltonian paths and circuits in a graph

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔	✔		✔	✔		✔	✔		✔		✔
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔		✔		✔		✔	✔		✔		✔

Course Content

UNIT I

An Introduction to Graph

The Definition of a Graph, Graph as Models, More Definitions, Vertex Degrees, Subgraphs.(Chapter 1, Section 1.1 to 1.5 of the Text Book)

UNIT II

Matrix Representation of graphs

Paths and cycles, The Matrix Representation of graphs, Fusion(Chapter 1, Section 1.6 to 1.8)
Trees and Connectivity: Definitions and Simple Properties, Bridges, Spanning Trees
(Chapter 2, Section 2.1 to 2.3 of the Text Book)

UNIT III

Trees and Connectivity(Continuity)

Connector Problems, Shortest Path Problems, Cut Vertices and Connectivity (Chapter 2, Section 2.4 to 2.6 of the Text Book)

UNIT IV

Euler Tours and Hamiltonian Cycles

Euler Tours, The Chinses Postman Problem, Hamiltonian Graphs, The Travelling Sallesman Problem. (Chapter 3 of the Text Book)

UNIT V

Matchings

Matching and Augmenting paths; The marriage problem; The personnel assignment problem; The optimal Assignment problem. (Chapter 4 of the Text Book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Graph Theory to Real life Problem /Problem Solving

Text Book

A first look at Graph Theory by John Clark & Derek Allan Holton, Allied Publishers Limited 1995.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. A First Course in Graph Theory by S.A.Choudham, MacmillanIndiaLtd.
2. Introduction to Graph Theory by RobinJ.Wilson,Longman Group Ltd.
3. Graph Theory with Applications by J.A.Bondy and U.S.R.Murthy, Macmillon,London

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 20: GRAPH THEORY				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	An Introduction to Graph	2	2	24
II	Matrix Representation of graphs	2	2	24
III	Trees and Connectivity(Continuity)	1	2	22
IV	Euler Tours and Hamiltonian Cycles	2	2	24
V	Matchings	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

GRAPH THEORY MODEL PAPER

Time:2 ½ hours Max.Marks:60M

Part-A

Answer any 5 questions from among the questions

I.Each question carries 2 marks – 5*2 = 10 M

A. Prove that every non-trivial connected graph contains at least two vertices that are not cut-vertices.

B. Find $\lambda(K_n)$

C. Give an example of a graph G such that both G and $\overline{G}$ are Eulerian.

D. Find the cyclic 1-factorization of K_6.

E. Explain the problem of five princes and the problem of Five Places.

F. Find $r(K_3,K_3)$

G. Define peripheral vertex, eccentric vertex and boundary vertex. Give example for each.

H. Prove that a connected graph G of order $n \geq 2$ has locating number $n-1$ if and only if $G \equiv K_n$

Part-B

Answer all questions from 2 to 6 each question carries 10 marks – 5 10=50M*

2. A. i. Prove that isomorphism is an equivalence relation on the set of all graphs.
   ii. Determine $Aut\ (C_5)$

OR

b. i. Prove that a graph of order at least 3 is nonseperable ifandonlyif every two vertices lie on a common cycle.
ii.For every graph G, prove that $\kappa(G) \leq \lambda(G) \leq \delta(G)$

3. A. i. Prove that a connected graph G contains an Eulerian trail if and only if exactly two vertices of G have odd degree and each Eulerian trail of G begins at one of these odd vertices and ends at the other.
   ii. Prove that Petersen graph is non-Hamiltonian.

OR

b. i. State and prove that Ore’s theorem

ii.Define $h(G)$ and $h^*(G)$ and prove that for every connected graph G, $h(G)=h^*(G)$

4. A. i. Prove that an on trivial connected graph G has a strong orientation if and only if G contains no bridge.
   ii. Prove that every tournament contains a Hamiltonian path

OR

B. i. Define edge independence number $\beta_1(G)$ and edge covering number $\alpha_1(G)$.Prove that for everygraph G of order n containing no isolated vertices, $\alpha_1(G) + \beta_1(G) = n$

ii. State and prove that Petersen's theorem.

5. A.i. Prove that for every graph$G$, $\chi(G)\leq 1+\max\{\delta(H)\}$, where the maximum is taken over all induced subgraphs $H$of G.

ii. State Vizing's theorem. If G is a graph or odd or der n and size m with $m > \frac{(n-1)\Delta G}{2}$, then prove that $\chi_1(G)=1+\Delta(G)$

OR

B.i. For every integer $k\geq 3$, prove that there exists a triangle-free graph with chro- matic number k.

ii. Prove that every graph of order $n\geq 3$ and size at least $n-1$+2 2is Hamiltonian

6. A.i. Define center of a graph and prove that center of every connected graph G is a sub graph of some block of G.

ii. Prove that an on trivial graph G is the eccentric sub graph of some graph if and only if every vertex of G has eccentricity 1 or no vertex of G has eccentricity 1.

OR

B. i. For a connected graph G, prove that a vertex v is a boundary vertex of G if and only if v is not an interior vertex of G.

ii. Define detour distance and prove that detour distance is a metric on the vertex set of every connected graph.

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SEMESTER-VIII

COURSE 21: ADVANCED ALGEBRA

Course Outcomes

After successful completion this course, the student will be able to

CO1. Define modules, sub modules and give some examples of them.

CO2.understand reducible modules, free modules and be able to find the rank of a linear mapping

CO3.understand Einstein's criteria for irreducible polynomials and algebraic extensions

CO4.understand splitting fields and finite fields

CO5.understand the Fundamental theorem of Galois Theory.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔	✔		✔	✔		✔	✔		✔		✔
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔		✔		✔		✔	✔		✔		✔

Course Content

UNIT I

Algebraic extension of fields

Irreducible polynomials and Eisenstein's criterion-Adjunction of roots-Algebraic extensions-Algebraically closed fields. (Sections 15.1 to 15.4 of the Chapter 15 in the prescribed text book.)

UNIT II

Normal and separable extensions

Splitting fields-Normal extensions-multiple roots-finite fields.(Sections 16.1 to 16.4 of the Chapter 16 in the prescribed text book.)

UNIT III

Normal and separable extensions: Separable extensions.

Galois Theory: Automorphism groups and fixed fields- fundamental theorem of Galois Theory. (Section 16.5 of the Chapter 16 and Sections 17.1 to 17.2 of the Chapter 17 in the prescribed text book.)

UNIT IV

Galois Theory

Fundamental theorem of algebra. Galois Theory and Applications of Galois Theory to Classical problems: Roots of unity and cyclotomic polynomials-Cyclic extensions (Section 17.3 of the Chapter 17 and sections 18.1and 18.2 of the Chapter 18 in the prescribed text book.)

UNIT V

Applications of Galois Theory

Applications of Galois Theory to Classical problems: Polynomials solvable by radicals-symmetric functions-Ruler and compass constructions. (Sections 18.3 and 18.4 of the Chapter 18 in the prescribed text book.)

Activities

Seminar/ Quiz/ Assignments/ Applications of Algebra to Real life Problem /Problem Solving

Text Book

Basic Abstract Algebra by P.B.Battacharya, S.K.jain, S.R.Nagpaul, Cambridge University Press.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Topics in Algebra by I.N.Herstein,2nd Edition,JohnWiley & Sons
2. Algebra by SergeLang, Revised Third Edition, Springer
3. Algebra by Thomas W.Hungerford, Springer.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 21: ADVANCED ALGEBRA				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Algebraic extension of fields	2	2	24
II	Normal and separable extensions	2	2	24
III	Normal and separable extensions: Separable extensions	1	2	22
IV	Galois Theory	2	2	24
V	Applications of Galois Theory	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

COURSE 21: ADVANCED ALGEBRA MODEL PAPER

Time: 2 ½ Hours **Max. Marks: 60M**

1. Answer any 5 question from the following: **5x2=10 Marks**

a) Let $f(x) \in F[x]$ be a polynomial of degree >1. If $F(\alpha) = 0$ for some $\alpha \in F$ then prove that f(x) is reducible over F.

b) If E is a finite extension of F then prove that E is an algebraic extension of F.

c) Prove that the degree of the extension of the splitting field of $x^3 - 2 \in Q[x]$ is 6.

d) Show that a finite field F of p^n elements has exactly one subfield with p^m elements for each divisor m of n.

e) Prove that Q($\sqrt{2}, \sqrt{3}) = Q(\sqrt{2} + \sqrt{3}\,)$

f) Show that the Galois group of $x^4 + x^2 + 1$ is same as that $x^6 - 1$ and is of order 2.

g) Prove that all splitting fields over the finite fields are cyclic extensions.

h) Show that it is possible to trisect 54^θ using ruler and compass.

Answer any 5 question from the following: **5x10=50 Marks**

2. a) Prove that $x^2 - 2$ is irreducible over Q.

(OR)

b) State and prove that Kronecker theorem.

3. a) Prove that the prime field of a field F is either isomorphic to Q or to Z/(p), p is prime.

(OR)

b) Let f(x) be an irreducible polynomial over F. then prove that f(x0 has a multiple root iff $f'(x) = 0$.

4. a) Let H be a finite subgroup of the group of automorphisms of a field E then prove that [E:E_H] = $|H|$

(OR)

b) State and prove that fundamental theorem of Galois Theory.

5. a) State and prove that fundamental theorem of algebra.

(OR)

b) Let F be a field and let nbe a positive integer then prove that there exists a primitive nth root of unity in some extension E of F iff either char F = 0 or char F∤n.

6. a) If p is a prime number and if a subgroup G of S_p is a transitive group of permutations containing a transposition (a,b) then prove that G = S_p

(OR)

b) Express the symmetric function ${x_1}^3 + {x_2}^3 + {x_3}^3$ as rational functions of elementatry symmetric functions.

SEMESTER-VIII
COURSE 22: ADVANCED LINEAR ALGEBRA

Course Outcomes

Upon successful completion of this course student should be able to

CO1. Understand the basic to the analysis of a single linear transformation on a finite- dimensional vector space and the analysis of characteristic values and the rational and Jordan canonical forms.

CO2. Understand concept of finite-dimensional inner product spaces and basic geometry, relating orthogonalization and unitary operators and normal operators.

CO3. Know the Jordan form, computation of invariant factors

CO4. Know the inner product spaces and their properties

CO5. Know about unitary operators and Normal operators

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔	✔		✔	✔		✔	✔		✔		✔
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔		✔		✔		✔	✔		✔		✔

Course Content
UNIT-I
Elementary Canonical Forms

Introduction – Characteristic Values – Annihilating Polynomials –invariant subspaces – Simultaneous Triangulation – Simultaneous Diagonalization, Simultaneous
(Chapter 6, Section 6.1 to 6.5 of the text book)

UNIT-II
Elementary Canonical Forms (Continued)

Direct – sum Decompositions – invariant direct sums – the primary decomposition theorem
(Chapter 6, Section 6.6 to 6.8 of the text book)The Rational and Jordan Forms: cyclic subspaces and Annihilators – cyclic decompositions and the rational form.(Chapter 7, Section 7.1 to 7.2 of the text book)

UNIT-III
Elementary Canonical Forms (Continued)

The Jordan Form – Computation of Invariant Factors – Semi Simple Operators.(Chapter 7, Section 7.3 to 7.5 of the text book)

UNIT-IV
Inner product spaces

Inner products, Inner product spaces, Linear functional and adjoints,(Chapter 8, Section 8.1 to 8.3 of the text book)

UNIT - V
Inner product spaces(continued)

Unitary operations, Normal operators (Chapter 8, Section 8.4 to 8.5 of the text book)

Activities

Seminar/ Quiz/ Assignments/ Applications of Linear Algebra to Real life Problem /Problem Solving

Text Book

Linear Algebra by Kenneth Hoffman and Ray Kunze, second edition, Prentice Hall of India Private Limited, New Delhi.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. First Course in Linear Algebra by Bhattacharya, P.B., Jain, S.K and Nagpal, S.R., Wiley Eastern Ltd. New Delhi

2. Linear Algebra by Henry Helson, Hindustan Book Agency (1994)

3. Topics in Algebra by I.N. Herstein, Second edition (Wiley Eastern Ltd.)

4. Algebra by M. Artin, Prentice - Hall of India private Ltd.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 22: ADVANCED LINEAR ALGEBRA				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Elementary Canonical Forms	2	2	24
II	Elementary Canonical Forms (Continued)	2	2	24
III	Elementary Canonical Forms (Continued)	1	2	22
IV	Inner product spaces	2	2	24
V	Inner product spaces(continued)	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MAHARAJHA'S COLLEGE (AUTONOMOUS) : : VIZIANAGARAM-2
FOURTH B.sc., EIGHT SEMESTER- MODEL PAPER
MATHEMATICS
ADVANCED LINEAR ALGEBRA

Time: 2 ½ Hours **Max. Marks: 60M**

1.Answer any FIVE questions. Each question carries 2 Marks **5X2 = 10M**

A. Define characteristic polynomial. Prove that similar matrices have the same characteristic polynomial.

B. Find the minimal polynomial for matrix A = $\begin{bmatrix} 3 & 1 & -1 \\ 2 & 2 & -1 \\ 2 & 2 & 0 \end{bmatrix}$

C. If $W_1, W_2, \ldots\ldots\ldots W_k$ be subspaces of finite dimensional vector space V such that $W = W_1 + W_2 + \ldots\ldots\ldots + W_k$ than prove that the following are equivalent

i) $W_1, W_2, \ldots\ldots\ldots W_k$ are independent

ii) For each j, $2 \leq j \leq k$, we have $W_j \cap (W_1 + W_2 + \ldots\ldots + W_{j-1}) = \{0\}$.

D. If W_1 be any subspace of finite dimensional vector space V then prove that there is a subspace W_2 of V such that $V = W_1 \oplus W_2$.

E. Find the Rational forms of the real matrix $\begin{bmatrix} c & 0 & -1 \\ 0 & c & 1 \\ -1 & 1 & c \end{bmatrix}$

F. Let T be a linear operator on V and minimal polynomial for T is irreducible over F. Then T is semi- simple.

G. Find the Jordan form of the matrix A = $\begin{bmatrix} 3 & 2 & -3 \\ -1 & 2 & 1 \\ 0 & 1 & 1 \end{bmatrix}$.

H. Prove that an orthogonal set of non-zero vectors is linearly independent.

Answer ALL questions. Each question carries 10 marks. **5X10 = 50M**

2. a) Let T be the linear operator on R^2 which is represented in the standard ordered basis by the matrix A = $\begin{bmatrix} 5 & -6 & -6 \\ -1 & 4 & 2 \\ 3 & -6 & -4 \end{bmatrix}$. Prove that T is diagonalizable.

(OR)

b) If T be a linear operator on finite dimensional vector space V over the field F, then T is triangulable if and only if the minimal polynomial for T is a product of linear polynomials over F.

3. a) State and Prove that Primary Decomposition Theorem.

(OR)

b) State and Prove that Generalized Cayley Hamilton Theorem.

4. a) If T be a linear operator on finite dimensional vector space V over an algebraically closed field F, then T is semi – simple if and only if T is diagonalizable.

(OR)

b) If M be an mxn matrix with entries in the polynomial algebra F[x] then M is equivalent to a matrix N which is in normal form.

5. a) Prove that finite dimensional inner product space has an orthonormal basis.

(OR)

b) State and Prove that Bessel's inequality.

6. a) On a finite dimensional inner product space of positive dimension , every self – adjoint Operator has a characteristic vector.

(OR)

b) If U be a linear operator on finite dimensional inner product space V then U is unitary if and only if the matrix of U in some ordered orthonormal basis is an unitary matrix.

SEMESTER-VIII
COURSE 23: ADVANCED TOPOLOGY

Course Outcomes

After successful completion this course, the student will be able to

CO1. Define T_1-space, T_2 – space

CO2. Understand Urysohn's Lemma, and the Tietz's extension theorem

CO3. Understand the Stone – Chech compactification,

CO4. Understand and can define the Connectedness of a topological space

CO5. Understand the Weierstrass approximation theorem and Stone-Weierstrass theorems.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔		✔	✔		✔	✔		✔	✔		✔	✔	✔
CO02	✔	✔		✔				✔			✔		✔		
CO03	✔		✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	✔	✔	✔
CO05	✔	✔		✔		✔		✔		✔	✔		✔		✔

Course Content
UNIT-I
Separation

T1 spaces and Hausdorff spaces – Completely regular spaces and normal spaces – Urysohn's lemma and the Tietze's extension theorem. (Chapter 5: Sections 26 to 28 Prescribed text book).

UNIT-II
Separation (continued)

The Urysohn imbedding theorem – The Stone – Chech compactification. (Chapter 5: Sections 29 to 30 Prescribed text book). Connectedness: Connected spaces– connectedness of Rn and Cn . (Chapter 6: Section 31 Prescribed text book).

UNIT-III
Connectedness (continued)

The components of a space – Totally disconnected spaces – Locally connected spaces. (Chapter 6: Sections 32 to 34 prescribed text book)

UNIT-IV
Approximation

The Weierstrass approximation theorem - The Stone-Weierstrass theorems (Chapter 7: Section 35 to 36 Prescribed text book).

UNIT-V
Approximation (continued)

Locally compact Hausdorff spaces – The extended Stone Weierstrass theorems. (Chapter 7: Sections 37 to 38 Prescribed text book).

Activities

Seminar/ Quiz/ Assignments/ Applications of Topology to Real life Problem /Problem Solving

Text Book

Introduction to Topology and Modern Analysis by G. F. Simmons, International Student edition – McGraw – Hill Kogakusha, Ltd.

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference Books
1. Schaum's Outlines: General Topology by Seymour Lipschutz
2. Topology: A first Course by James Munkres,Prentice-Hall Pvt. Ltd.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 23: ADVANCED TOPOLOGY				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Separation	2	2	24
II	Separation (continued)	2	2	24
III	Connectedness (continued)	2	2	22
IV	Approximation	1	2	24
V	Approximation (continued)	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

MAHARAJHA'S COLLEGE (AUTONOMOUS) : : VIZIANAGARAM-2
FOURTH B.sc., EIGHT SEMESTER- MODEL PAPER
(Paper – VIII: ADVANCED TOPOLOGY)

Time: $2\frac{1}{2}$ Hrs **Max. Marks: 60M**

1. Answer any FIVE questions. Each question carries 2 marks **5X2=10M**

A. Prove that every metric space is a Hausdroff space.

B. Prove that every normal space is completely regular.

C. Prove that every closed subspace of a product of closed intervals is a compact hausdorff space.

D. If a topological space X is disconnected then there exists a continuous mapping of X onto the discrete two point space {0,1}

E. Prove that the components of a totally disconnected space are its points.

F. If Y is an open subbase of a locally connected space X then each component of Y is open in X.

G. If X be an arbitrary topological space then every closed subalgebra of C(X,R) is also a closed sublattice of C(X,R).

H. State the complex stone weierstrass theorem.

Answer ALL the following questions. Each question carries 10 marks. **5X10 =50M**

2. a) Prove that every compact Hausdorff space is normal.

(OR)

b) State and prove that Tietze extension theorem.

3. a) State and prove that the Uryshon imbedding theorem.

(OR)

b) Prove that a subspace of the real line R is connected if and only if it is an interval.

4. a) If $\{A_i\}$ is a non-empty classes of connected subspaces of topological space X such that $\bigcap_{i\in I} A_i$ is non- empty then A= $\bigcup_{i\in I} A_i$ is connected subspace of X.

(OR)

b) Let X be a compact haussdorff space then prove that X is totally disconnected if and only if it has an open base whose sets are closed.

5. a) State and prove that Weierstrass approximation theorem.

(OR)

b) State and prove that Real stone weirstrass theorem.

6. a) Prove that $C_0(X,R)$ and $C_0(X,C)$ are closed subalgebras of C(X,R) and C(X,C).

(OR)

b) State and prove that Extended stone weirstrass theorem.

SEMESTER-VIII
COURSE 24: ORDINARY DIFFERENTIALEQUATIONS

Course Outcomes

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

CO1. Comprehend the bridge between the real function theory and theory of ordinary differential equations

CO2. Understand the basic theory behind existence, uniqueness, continuity of solutions of ordinary differential equations

CO3. Realize the dependence of solutions on various parameters involved in the differential equations

CO4. Recognize the significance studying differential systems and its utility in understanding higher order differential equations

CO5. Figure out qualitative behavior of solutions of differential equations of various orders.

CO-PO-PSO MATRIX															
CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔	✔	✔		✔	✔	✔			✔		✔		
CO02	✔	✔	✔			✔	✔	✔		✔	✔		✔		✔
CO03	✔		✔	✔	✔	✔	✔	✔	✔		✔	✔	✔	✔	
CO04	✔	✔	✔	✔		✔	✔	✔			✔	✔	✔		
CO05	✔	✔	✔	✔		✔	✔	✔		✔	✔		✔		✔

Course Content
Unit I
Real Function Theory

Essential concepts from Real Function Theory – The basic problem -The fundamental existence and uniqueness theorem –examples to demonstrate the theory- continuation of solutions (Sections 10.1, 10.2 of the prescribed text book)

Unit II
Existence and Uniqueness

Dependence of solutions on initial conditions – dependence of solutions on parameters (causal function f) - Existence and Uniqueness theorems for systems – existence and uniqueness theorems for higher order equations – examples (Sections 10.3, 10.4 of the prescribed text book)

Unit III
Linear differential systems

Introduction to the theory of linear differential systems – Theory and properties of Homogeneous linear systems (Sections 11.1 - 11.3 of the prescribed text book)

Unit IV
Homogeneous and Non-homogeneous Systems

Theory of non-homogeneous linear systems – Theory and properties of the nth order homogeneous linear differential equations (Sections 11.4 - 11.6 of the prescribed text book)

Unit V
Higher order non-homogeneous Linear Equations

Theory of nth order Non homogeneous Linear equations – Sturm theory – Sturm Liouville Boundary value problems (Sections 11.7, 11.8, 12.1 of the prescribed text book)

Activities
Seminar/ Quiz/ Assignments/ Applications of Ordinary Differential Equations to Real life Problem /Problem Solving

Text Book
Differential Equations by Shepley L. Ross, Wiley India

Web Sources
https://swayam.gov.in/explorer?ncCode=CEC

Reference books
1. Differential Equations with Applications and Historical Notes by George F. Simmons,(3rd edition). CRC Press. Taylor & Francis.
2. An Introduction to Ordinary Differential Equations by Earl A. Coddington, Prentice-Hall of India

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 24: ORDINARY DIFFERENTIALEQUATIONS				
UNIT	**TOPICS**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Real Function Theory	2	2	24
II	Existence and Uniqueness	2	2	24
III	Linear differential systems	1	2	22
IV	Homogeneous and Non-homogeneous Systems	2	2	24
V	Higher order non- homogeneous Linear Equations	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

ORDINARY DIFFERENTIAL EQUATIONS

Time: 2 ½ Hours Max. Marks: 60M

SECTION-A

1. ANSWER ANY FIVE OF THE FOLLOWING QUESTIONS 5X2=10M

A. Show that $f_n(x)x - \frac{x^n}{n}, 0 \leq x \leq 1, n = 1,2,3,..$converges uniformly.

B. What is Lipschitz constant.

C. Investigate if $f(x,y) = y^{\frac{2}{3}}$ satisfies Lipschitz condition on $\{(x,y) \,/\, |x| \leq 1, |y| \leq 1\}$. Justify your argument.

D. Establish existence and uniqueness of solutions for an initial value problem associated with non-homogeneous nth order linear differential equation.

E. Establish Abel-Liouville formula.

F. Discuss the method of reduction of order for the *n*th order homogeneous linear differential equation.

G. Transform a second order linear homogeneous differential equation into an equivalent self adjoint equation.

H. State the Sturm Comparison Theorem.

SECTION-B

ANSWER THE FOLLOWING QUESTIONS 5X10=50M

2. i. Distinguish between point wise convergence and uniform convergence for a sequence of functions

ii. Discuss the concept of continuation of solutions for the initial value problem $y' = f(x,y), y(x_0) = y_0$.

OR

2. (b). State and prove the existence and uniqueness theorem for the initial value problem $y' = f(x,y), y(x_0) = y_0$.

3. a. State and prove the resultthat establishes continuity of the solution $\emptyset(x, y_0)$ of the initial value problem $y' = f(x,y), y(x_0) = y_0$ with respect to y_0.

OR

3. b. Investigate and identify an interval on which the Initial value problem $(x^2 - x - 6)\frac{d^2y}{dx^2} + (x^2 + 4)\frac{dy}{dx} + \frac{1}{2x+3}y = e^{-x}, y(2) = 0, y'(2) = 4$ has unique solution.

4. a. Define Wronskian of n vector functions. Establish linear independency of n solutions of $x' = A(t)x$ through Wronskian related properties of these n solutions.

OR

4. b. Establish a relation between a fundamental matrix and an arbitrary solution of $x' = A(t)x$ and obtain a form for the unique solution of $x' = A(t)x, x(t_0) = x_0$ in terms of the fundamental matrix.

5. a. Derive variation of parameters formula for the non homogeneous vector differential equation.

OR

5 b. Given that the differential equation $t^3\frac{d^3x}{dt^3} - (t+3)t^2\frac{d^2x}{dt^2} + 2t(t+3)\frac{dx}{dt} - 2(t+3)x = 0$ has two linearly independent solutions of the form t^n, where n is an integer, find the general solution.

6. a. State and prove Sturm Separation Theorem

OR

6. b. Establish a necessary and sufficient condition for a second order linear homogeneous differential equation to be self adjoint.

SEMESTER-VIII
COURSE 25: OPERATIONS RESEARCH

Course Outcomes

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

CO1. Study on LPP enables to arrive at an optimal decision/solutions in difficult decision making.

CO2. Study on LPP applied to problems pertaining to both profit making and low cost related real world situation.

CO3. Study on Post optimal analysis enables into manage and control resource allocation.

CO4. Study of Transportation problem and Assignment problem introduces to implementing simplex procedure for more variables using Modi method stepping stone method and Hungary method

CO5. Study on games and strategies helps in decision making for problems with competitive situations like candidates for elections, marketing campaigns by different companies etc.

CO-PO-PSO MATRIX

CO NO.	PO 01	PO 02	PO 03	PO 04	PO 05	PO 06	PO 07	PO 08	PO 09	PO 10	PSO 01	PSO 02	PSO 03	PSO 04	PSO 05
CO01	✔	✔				✔	✔				✔		✔		
CO02	✔	✔			✔	✔	✔				✔	✔	✔	✔	
CO03	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔	✔
CO04	✔	✔				✔	✔				✔		✔		
CO05		✔			✔	✔	✔	✔		✔	✔		✔		✔

Course Content

UNIT-I

Linear Programming: Simplex Method

Introduction-Fundamental properties of solutions-The computational procedure-Use of artificial variables. (Sections 4.1 to 4.4 of the Chapter 4 in the Prescribed Text Book)

UNIT-II

Duality in Linear Programming

Introduction-General Primal-Dual pair-Formulating a Dual problem-Prime-Dual Pair in matrix form-Duality theorems-Complementary slackness theorem Duality and simplex method. (Sections 5.1 to 5.7 of the Chapter 5 in the Prescribed Text Book)

UNIT-III

Duality in Linear Programming

Economic Interpretation of Duality, Dual Simplex method Post-optimal Analysis: Introduction-Variation in the cost vector-Variation in the requirement vector-variation in the coefficient matrix-Structural variations- Applications of Post-optimal Analysis. 12 hours (Sections 5.8, 5.9 and 6.1 to 6.6 of the Chapters 5 and 6 in the Text Prescribed Book)

UNIT-IV

Transportation Problem and Assignment Problem

Introduction-General transportation problem-The transportation table-Solution of a transportation problem-Finding an initial basic feasible solution-Test for optimality-Degeneracy in Transportation problem-Transportation Algorithm (MODI Method)- Introduction -Mathematical formulation of the problem-The Assignment method-Special cases in Assignment problem-A typical Assignment problem. (Sections 10.1 to 10.3 and 10.8 to 10.11 of the Chapter 10 in the Prescribed Text Book.) (Sections 11.1 to 11.5 of the Chapter 11 in the Prescribed Text Book)

UNIT-V
Games and Strategies

Introduction-Two-person zero-sum games-some basic terms-The maximin-minimax principle-Games without saddle points-Mixed strategies-Graphic solution of 2xn and mx2 games. (Sections 17.1 to 17.6 of the Chapter 17)

Activities

Seminar/ Quiz/ Assignments/ Applications of Operations Research to Real life Problem /Problem Solving

Text Book

Operations Research by Kanti Swarup, P.K. Gupta and Man Mohan Sultan Chand & Sons, New Delhi, 2006.

Websourses:

https://swayam.gov.in/explorer?ncCode=CEC

Reference Books

1. Operations Research, An Introduction byHamdy A Taha, Maxwell Macmillan International Edition, New York, 1992.
2. Operations Research Theory, methods and Applications by S.D. Sarma, kedarnath Ramnath publications, 2008.

BLUE PRINT FOR PREPARING QUESTION PAPER				
COURSE 25: OPERATIONS RESEARCH				
UNIT	**TOPIC**	**S.A.Q (Include Choice)**	**E.Q (Include Choice)**	**MARKS ALOTED**
I	Linear Programming: Simplex Method	2	2	24
II	Duality in Linear Programming	2	2	24
III	Duality in Linear Programming	1	2	22
IV	Transportation Problem and Assignment Problem	2	2	24
V	Games and Strategies	1	2	22
TOTAL		8	10	116
S.A.Q. = SHORT ANSWER QUESTIONS		5*2= 10 MARKS		
E.Q. = ESSAY QUESTIONS		5*10= 50 MARKS		
TOTAL MARKS		60 MARKS		

OPERATIONS RESEARCH

Time: 2 ½ Hours Max. Marks: 60M

SECTION-A

1. ANSWER ANY FIVE OF THE FOLLOWING QUESTIONS 5X2=10M

A. Describe simplex method of solving linear programming problems?
B. Give the properties of a Linear Programming Problem?
C. What is duality in LPP?
D. What are the steps to solution of a LP problem by graphical method?
E. Distinguish between transportation problem and assignment problem?
F. Give two areas for the application of assignment problem?
G. What is competitive situation called a game?
H. What is game in the game theory?

SECTION-B

ANSWER THE FOLLOWING QUESTIONS 5X10=50 M

2. (a) Solve the following LPP by simplex method

$$\text{Maximize } z = x_1 - 3x_2 + 2x_3$$

$$\text{Subject to } 3x_1 - x_2 + 2x_3 \le 7$$

$$-2x_1 + 4x_2 \le 12$$

$$-4x_1 + 3x_2 + 8x_3 \le 10$$

$$x_1, x_2, x_3 \ge 0.$$

OR

(b) Use two phase simplex method and solve

$$\text{Minimize } z = x_1 - x_2 + x_3$$

Subject to

$$x_1 - 3x_2 + 4x_3 = 5$$

$$x_1 - 2x_2 \le 3$$

$$2x_2 + x_3 \ge 4$$

$$x_1 \ge 0, x_2 \ge 0, \quad x_3 \textit{ unrestricted}.$$

3. (a)(i) Use the LPP

Minimize $z = 4x_1 + 6x_2 + 18x_3$

$$\text{Subject to } x_1 + 3x_2 \ge 3$$

$$x_2 + 2x_3 \ge 5$$

$x_1, x_2, x_3 \ge 0.$ and show that dual of a dual is primal.

(ii) Use duality and solve the LPP.

Maximize $z = x_1 - x_2 + 3x_3 + 2x_4$

Subject to $x_1 + x_2 \geq -1$

$x_1 - 3x_2 - x_3 \leq 7$

$x_1 + x_3 - 3x_4 = -2$

$x_1, x_2, x_3, x_4 \geq 0.$

OR

(b) Obtain dual of LPP and solve

Maximize z $= 2x_1 + 9x_2 + x_3$

Subject to $x_1 + 4x_2 + 2x_3 \geq 5$

$3x_1 + x_2 + 2x_3 \geq 4$

$x_1, x_2, x_3 \geq 0.$

4. (a) Use dual simplex method to solve the LPP

Minimize z $= 10x_1 + 6x_2 + 2x_3$

Subject to $-x_1 + x_2 + x_3 \geq 1$

$3x_1 + x_2 - x_3 \geq 2$

$x_1, x_2, x_3 \geq 0.$

OR

(b) Consider the L.P.P

Maximize z $= 2x_1 + 4x_2 + 3x_3$

Subject to $x_1 + 4x_2 + 3x_3 \leq 240$

$2x_1 + x_2 + 5x_3 \leq 300$

$x_1, x_2, x_3 \geq 0.$

(i) Suppose the vector b = $[240, \quad 300]$ is changed **to b**+ $\delta b = [300, \quad 400]$, then find the effect of the change on the optimal solution.

(ii) Suppose the cost vector c = $(2, \quad 4, \quad 3)$ is changed to **c**+ $\delta c = (1, \quad 4, \quad 4)$ Then find the effect of this change on the optimal solution.

5. (a) Solve the transportation problem:

	I	II	III	IV	SUPPLY
1	5	7	13	10	700
2	8	6	14	13	400
3	12	10	9	11	800
Remand	200	600	700	400	

OR

(b) Solve the assignment problem.

	A	B	C	D
1	30	27	31	39
2	28	18	28	37
3	33	17	29	41
4	27	18	30	43
5	40	20	27	36

6.(a). Solve the game with pay off matrix.

$$\begin{array}{c} \\ A1 \\ A2 \\ A3 \end{array} \begin{array}{c} \begin{array}{ccc} B1 & B2 & B3 \end{array} \\ \begin{pmatrix} -2 & 15 & -2 \\ -5 & -6 & -4 \\ -5 & 20 & -8 \end{pmatrix} \end{array}$$

(OR)

6. (b) Solve the game graphically.

B

	2	2	3	−2
A	4	3	2	6

9. Learning and Teaching Process

Pedagogical Approaches

Teaching learning techniques include

(1) **Lecture based teaching-learning**

(2) Group- teaching and learning

(3) **Individual learning/self-study**

(4) Inquiry based learning;

(5) Kinaesthetic learning

(6) **Game Based learning**

(7) Expeditionary learning

(8)Technology based learning

(9) Peer teaching

(**10)Learning through problem-solving**

- **Lecture based teaching-learning:** It is a traditional method involving direct instruction from a teacher to students.
- **Group teaching and learning:** Students are divided into small groups to work together on learning activities.
- **Individual learning/self-study:** It involves self-paced learning where students use resources like text books, online materials etc.
- **Inquiry-based learning:** This is a studentcentered teaching approach where learners ask questions, conduct investigations, and develop their own understanding of concepts. It emphasizes critical thinking.
- **Peer teaching:** Students teach each other under the guidance of an instructor.
- **Learning through problem solving:** It emphasizes critical thinking, creativity, and the application of knowledge to find solutions.
- **Blended Learning:** Combining traditional face-to-face teaching with online resources for a holistic approach.
- **Flipped Classroom:** Students review materials before hand and class room time is used for interactive problem solving.

10 & 11. COURSE STRUCTURE:

MAHARAJAH"S COLLEGE (A) of is rated as one among the best colleges in the state of Andhra Pradesh as it set up highest standards in all areas of curricular, co-curricular and extra-curricular activities and in students' placements. Student is supposed to study in 8 semesters of 4 years of honors course.

B.Sc (Honours) with Single Major

Semester	Major* (4 Cr)			Minor (4 Cr)			AECC (3 Cr)			Multi Disny' (2 Cr)			Skill Enhancement Courses (2Cr)			OOTC			Env. Edn (2 Cr)			Total		
	C	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***	**C**	***H***	***Cr***
Sem 1	2*	10	8				2	8	6	1	2	2	2	4	4							7	24	20
Sem 2	2	6+4	8	1	3+2	4	2	8	6				2	4	4							7	27	22
Community Service Project of 180 hours with 4 Credits. Student is eligible for Exit Option-1 with the award of Certificate in respective discipline																								
Sem 3	4	12+8	16	1	3+2	4				1	2	2	1	2	2							7	29	24
Sem 4	3	9+6	12	2	6+4	8				1	2	2	1	2	2							7	29	24
Short-Term Internship/Apprenticeship/OJT of 180 hours with 4 Credits. Student is eligible for Exit Option-2 with the award of Diploma in respective major with minor																								
Sem 5	4	12+8	16	2	6+4	8													1	2	2	7	32	26
Sem 6	**Semester Internship/Apprenticeship/OJT with 12 Credits. Student is eligible for Exit Option-3 with the award of Degree in respetive major**																							
																				IKS#				
Sem 7	3	9+6	12										2*	6+4	8	1	2	2	1	2	0	6	29	22
Sem 8	3	9+6	12										2*	6+4	8	1	2	2	1	2	0	6	29	22
	21		84	6		24	4		12	3	6	6	10	32	28	2	4	4	2	4	0	47		**160**
20 Additional Credits for 10 month mandatory Internship/OJT/Apprenticeship																								
C	Courses				**H**	Hours				**Cr**	Credits					**OOTC**	Open Online Transdisciplinary							
IKS#	Indian Knowledge Systems - Audit Course																							

1. **PROGRAM PATTERN:**

B.Sc (Honours)., The program is for 4 academic years and 8 semesters.

2. **AWARD OF DEGREE:**

A student will be declared eligible for the award of degree if he/she fulfills the following academic regulations.

a) A student shall be declared eligible for the award of degree, if he/she pursues a course of study for not less than four academic years and not more than eight academic years from the date of admission.

b) The student shall register forcredits:

Name of theProgramme	**No of Credits**
B.Sc	180

The student shall secure all the credits.

c) The medium of instruction for the entire under graduate program will be in **English** only.

d) Students who fail to complete Four Years Course of study within 8 years shall forfeit their seat and their admission shall stand cancelled.

3. **COURSES OFFERED:**

Name of the Course	**Name of the subject**
B.Sc.(Honours)	Botany Chemistry Computer Science Data-Science Geology Mathematics Physics Zoology

GUIDELINES TO BE FOLLOWED FOR THE ALLOTMENT OF MINOR COURSES

The guidelines for the allotment of minor courses to the first year students of A1 Regulation (R23) from the AY 2023-24 are given hereunder:

1. All the Theory courses offering under the category of minor shall have 3 credits.
2. All the Laboratory course offering under the categories of minor shall have 1 credit.
3. One credit of any theory course under the category of minor shall be delivered through 1 hour per week and one credit of any laboratory course under the category of minor shall be delivered through 2 hours per week.
4. The students have to choose a minor in the second semester, onwards up to fifth semester, cutting across the disciplines or from allied disciplines.
5. A student has to study 6 courses in the chosen minor with 24 credits.
6. To choose a minor course, the student has to fulfill the eligibility requirement of studying the same specialization in his/her Intermediate course. For choosing the minor as Computer Science, the student has to study Mathematics as one of the subjects in his/her Intermediate.

7. A student, if the student wishes, can complete an additional second minor through online from approved sources during the period of study and submit the credits to the institution/university for inclusion in the Degree certificate.
8. The list of minors, offering programs, and the respective eligibility criteria is given hereunder:

S.No	Program/ Departments	Title of the Minor	Eligibility for opting
1	B.Sc.	Botany	Bi.PC. in Intermediate
		Chemistry	MPC/Bi.PC in Intermediate
		Mathematics	MPC/MEC in Intermediate
		Physics	MPC/Bi.PC in Intermediate
		Statistics	MPC/MEC in Intermediate
		Zoology	Bi.PC. in Intermediate
		Computer Science	MPC/MEC in Intermediate
		Data Science	Any Science group in Intermediate

9. Allotment of minor courses to the Ist year students shall be subject to the availability of resources and logistics. Any minor course shall be conducted only after satisfying minimum criteria with respect to strength of the section.
10. Allotment of minor courses to the Ist year students shall be considered based on the merit of the students obtained in Intermediate education. However, the final decision will be based on the recommendation of the Management of the institution.
11. A list of possible minors and the departments offering the respective minors is given below:

S.No	Program	Minor	Eligibility for opting
1	B.Sc(H) Mathematics	Physics, Chemistry, Statistics, Computer Science	M.P.C. in Intermediate
		Data Science	MPC/MEC/Bi.PC in Intermediate

4.DISTRIBUTION AND WEIGHTAGE OF MARKS:

a). **Theory:**

All Theory courses will have 5 units and assessed for 100 marks, of which, 40 marks for internal assessment and 60 marks for semester end examination.

Internal Assessment:

Internal Assessment - 30 Marks
Assignments - 10Marks

- Two Internal Assessmentshall be conducted. One on first 50% of the syllabus and second on remaining 50% of the syllabus.
- Each Internal Assessment consists Subjective test

- Each subjective test shall be conducted for 60 Minutes and assessed for 30 marks
- Assignments shall be assessed for 10 marks
- Final Internal Assessment marks can be calculated from the average of the two Internal Assessments.

Semester End Examinations:

- External examination is for 60 marks (180 min). Question paper contains Essay questions and short answer questions.

Assignments: The student has to submit 5 assignments (1 for each unit) and assessed for 10 marks. Each assignment shall consist of 4 questions (4X10 = 40 marks) and the same shall be scaled down to 10 marks. Average of 4 assignments shall be considered as final assignment marks.

5. ATTENDANCE REGULATIONS:

I. A student shall be eligible to appear for end semester examinations, if he or she acquires a minimum of 75% of attendance in aggregate of all the subjects (Theory & Lab.) for the semester.

II. Condonation of shortage of attendance in aggregate up to 10% (65% and above and below 75%) in each semester may be granted by the college academic committee.

III. Shortage of attendance below 65% in aggregate of all the subjects (Theory & Lab) for the semester shall not be Condoned.

IV. Detained student shall seek re- admission for that semester when offered within 4 weeks from the date of commencement of class work.

PROMOTION RULE (Based on attendance):

- A Student shall be promoted to the next semester on fulfillment of minimum attendance requirement (75%) of current semester
- A Student shall be pay examination fee for one of semesters out two Semesters(one academic year)

6.MINIMUM ACADEMIC REQUIREMENTS (Theory/ Practical):

A student is deemed to have satisfied the minimum academic requirements for a course on securing minimum 40% of marks in the semester end exam and minimum 40% of marks in the sum total of the internal marks and semester end marks.

7. GRADING SYSTEM:

Semester Grade Point Average (SGPA) for the current semester which is calculated on the basis of grade points obtained in all courses.

SGPA= Σ (course credits earned x Grade points) /
Σ (Total course credits in the semester.

CGPA= Σ (course credits earned x Grade points) up to successfully completed semesters) / Σ(Total course credits up to successfully completed)

The UGC recommends a 10-point grading system with the following letter grades as given below:

LetterGrade	**GradePoint**
O(Outstanding)	10
A+(Excellent)	9
A(VeryGood)	8
B+(Good)	7
B(AboveAverage)	6
C(Average)	5
P(Pass)	4
F(Fail)	0
Ab(Absent)	0

Illustration for **SGPA**

Course	**Credit**	**Grade letter**	**Grade point**	**CreditPoint** (Creditx Grade
Course1	3	A	8	3X 8= 24
Course2	4	B+	7	4X 7= 28
Course3	3	B	6	3X 6= 18
Course4	3	O	10	3X 10= 30
Course5	3	C	5	3X 5= 15
Course6	4	B	6	4X 6= 24
	20			139

Thus,**SGPA=139/20=6.95**

Illustrationfor**CGPA**

Semester1	**Semester2**	**Semester3**	**Semester4**
Credit:20 SGPA:6.9	Credit:22 SGPA:7.8	Credit:25 SGPA: 5.6	Credit:26 SGPA:6.0
Semester5	**Semester6**		
Credit:26 SGPA:6.3	Credit:25 SGPA: 8.0		

$$\text{CGPA} = \frac{20\ x6.9+22x7.8+25x5.6\ +26x6.0+26\ x6.3+25x8.0}{144} = 6.73$$

8.ELIGIBILITY FOR AWARD OF DEGREE:

A student shall be eligible for award of the degree if he/she fulfills the following conditions:

1) Successfully completes all the courses prescribed for the Program.
2) CGPA greater than or equal to 5.0 (Minimum requirementfor Pass),

9.AWARD OF CLASS:

Eligible Candidates for the award of Degree shall be placed in one of the following Classes based onCGPA.

CLASS	CGPA
First Class	≥ 6.5
Second Class	≥ 5.5 to< 6.5
Pass Class	≥ 5.0 to < 5.5

10.INSTRUCTION DAYS:

A semester shall have a minimum of 90 clear instruction days (including internal examinations).

11.SUPPLEMENTARY EXAMINATIONS:

Supplementary examinations shall be conducted for final year students of Vth&VIth semesters within 4 weeks from the date of announcement of results of regular examinations.

12.WITH HOLDING OF RESULTS: The result of a student shall be withheld

- If any case of pending disciplinary action ,
- Involvement in any sort of malpractices etc.
- Involvement in ragging.

13.AMENDMENTS TO REGULATIONS:

The Academic Council of M.R.College(Autonomous) reserves the right to revise, amend, change or nullify the Regulations, Schemes of Examinations, and/ or Syllabi or any other such matter relating to the requirements of the program which are compatible to the contemporary/emerging trends effectively meeting the needs ofsociety/industry/stake holding groups.