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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**College of Engineering Studies**

**Dehradun**

**COURSE PLAN**

Programme : B. Tech – Computer Science & Engineering All Branches

Course : Discrete Mathematical Structures

Course Code : MATH 231

No. of credits : 3

Semester : III

Session : 2018-19

Batch : 2017-21

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P.O. Bidholi, , Dehradun

**COURSE PLAN**

1. **PREREQUISITE:**
2. Basic Knowledge of Mathematics I and Mathematics II
3. **PROGRAM OUTCOMES (POs) and PROGRAM SPECIFIC OUTCOMES (PSOs)**

**B1. PROGRAM OUTCOMES (POs)**

Engineering Graduates will be able to:

PO1. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

PO2. **Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

PO3. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations.

PO4. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.

PO5. **Modern tool usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.

PO6. **The engineer and society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal and cultural issues and the consequent responsibilities relevant to the professional engineering practice.

PO7. **Environment and sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts and demonstrate the knowledge of, and need for sustainable development.

PO8. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

PO9. **Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

PO10. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.

PO11. **Project management and finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one’s own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.

PO12. **Life-long learning:** Recognize the need for, and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

**B2. Program Specific Outcomes (PSOs)**

Computer Science Engineering with specialization in **Cloud Computing** will be able to:

PSO1. Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques,

PSO2. Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.

PSO3: Understand and apply Cloud Computing architecture for scalable, secure and dynamically provisioned business oriented environment with optimized performance tuning and data reliability.

1. **COURSE OUTCOMES FOR DISCRETE MATHEMATICAL STRUCTURES:**

At the end of this course student should be able to

**CO1 :** Understand and interpret the fundamental mathematical structures like Set theory,

Relation and Functions

**CO2 :** Write recursive definitions of sequences and collections of objects

**CO3 :** Understand the concepts and applications of vector algebra

**CO4 :** Understand and interpret the basic concepts of Graph Theory

**CO5 :** Apply the use of Graph theory concepts solving various Computer Science and

Engineering problems.

**Table: Correlation of POs and PSOs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PO/CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 | PSO1 | PSO2 | PSO3 |
| CO1 | 3 | 3 | 1 | 1 |  |  |  |  |  |  |  | 1 | 1 |  |  |
| CO2 | 3 | 3 | 1 | 1 |  |  |  |  |  |  |  | 1 | 1 |  |  |
| CO3 | 3 | 2 | 1 | 1 |  |  |  |  |  |  |  | 1 | 1 |  |  |
| CO4 | 3 | 2 | 1 | 1 |  |  |  |  |  |  |  | 1 | 1 |  |  |
| CO5 | 3 | 2 | 1 | 1 |  |  |  |  |  |  |  | 1 | 1 |  |  |

1. WEAK 2. MODERATE 3. STRONG

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | Engineering Knowledge | Problem analysis | Design/development of solutions | Conduct investigations of complex problems | Modern tool usage | The engineer and society | Environment and sustainability | Ethics | Individual or team work | Communication | Project management and finance | Life-long Learning | Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques | Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms. | Understand and apply Cloud Computing architecture for scalable, secure and dynamically provisioned business oriented environment with optimized performance tuning and data reliability. |
| Course Code | Course Title | PO1 | PO2 | PO3 | PO4 | PO 5 | PO6 | PO 7 | PO8 | PO9 | PO 10 | PO 11 | PO12 | PSO 1 | PSO 2 | PSO 3 |
| MATH 231 | Discrete Mathematical Structures | 3 | 3 | 1 | 1 |  |  |  |  |  |  |  | 1 | 2 |  |  |

1. **COURSE OUTLINE:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Units** | **Contents** |
| 1. | Unit – I | Set Theory, Relation and Functions & theorem Proving Techniques |
| 2 | Unit – II | Vector algebra and Matrices Transformation |
| 3 | Unit – III | Trees and Basics of Graph Theory |
| 4 | Unit – IV | Graph Theory and its Applications |

1. **PEDAGOGY:**
2. Lectures using Board and PowerPoint
3. Discussions & Tutorials
4. Assessments (Class Test, Quiz, Assignments)
5. Concept diary (needs to be maintained by students – short and concise notes which includes course concepts that he/she has been undergone)
6. **COURSE COMPLETION PLAN:**

|  |  |
| --- | --- |
| Total Class sessions | 36 |
| Total Quizzes | 02 |
| Total Test | 02 |
| Total Assignment | 02 |

One Session=60 minutes

1. **EVALUATION & GRADING:**

Students will be evaluated based on the following 3 stages.

1. Internal Assessment - 30%
2. Mid-term Examination - 20%
3. End term Examination - 50%

**H1. INTERNAL ASSESSMENT: WEIGHTAGE – 30%**

Internal Assessment shall be done based on the following:

|  |  |  |
| --- | --- | --- |
| **Assessment** | **Points** | **Percentage** |
| Quiz (After completion of session 11 & 25 ) | 2 Quiz @ 15 points each. | 30% |
| Assignments (After end of session 17 &30 ) | 2 Assignments @ 10 points each. | 20% |
| Test (After completion of session 19& 33 ) | 2 Test @ 20 points each. | 40% |
| Conduct of the student (General discipline) | @10 points. | 10% |
| Total | 100 points | 100% |

**H2. Internal Assessment Record Sheet (including Mid Term Examination marks*)*** will be displayed online at the end of semester i.e. last week of regular classroom teaching.

**H3. CLASS TESTS/QUIZZES:** Two Class Tests based on descriptive type theoretical & numerical questions will be conducted as detailed above. Two Quizzes based on objective type questions will be held as detailed above. *The marks obtained by the students will be displayed a week before the start of Mid Term and End Term Examinations respectively.*

**H4. ASSIGNMENTS:** There will be two assignments before Mid Term and End Term Examination. Two week time (approx.) would be given to submit the Assignment. Those who fail to submit the assignments by the due date shall lose their marks.

**H5. GENERAL DISCIPLINE:** Based on student’s regularity, punctuality, sincerity and behavior in the class. The marks obtained by the students will be displayed at the end of semester.

**H6. MID TERM EXAMINATION: WEIGHTAGE – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination of Short and Long theory Questions. Date of showing Mid Term Examination Answer Sheets: Within a week after completion of mid semester examination.

**H7. END TERM EXAMINATION: WEIGHTAGE – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**H8. GRADING:**

The overall marks obtained at the end of the semester comprising all the above three mentioned shall be converted to a grade.

1. **DETAILED SESSION PLAN:**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Module /Session** | **Big Ideas/ Topics** | **Course Outcomes Addressed** | **Required Learning Resources (including media)** | | **Pedagogy/ Discussion/ Postings** | **Assessment** |
| **Module 1** | **Set Theory, Relation and Functions & theorem Proving Techniques** | | | | | |
| 1,2 | Set Theory, Definitions, Types, Venn Diagram, Proofs of Identities | CO1 | Refer Blackboard, Suggested Reading | | Lecture | Quizzes , Assignments,  Discussions & Class Tests |
| 3,4 | Relations, Definitions, Types, Composition, Representation  Equivalence Relation, Partial Ordering Relation, Job scheduling problem | CO1 | Refer Blackboard, Suggested Reading | | Lecture |
| 5.6 | Function, Definition, Mapping, Composite Functions, Recursively defined, Pigeonhole Principle | CO1 | Refer Blackboard, Suggested Reading | Lecture | |
| 7,8 | Theorem proving techniques:  Mathematical Induction  Proof by Contradiction | CO1 | Refer Blackboard, Suggested Reading | | Lecture |
| 9,10 | Generating functions | CO1, CO2 | Refer Blackboard, Suggested Reading | | Lecture |
| 11,12 | Recurrence Relation | CO1, CO2 | Refer Blackboard, Suggested Reading | | Lecture |
| 13 | Reflection & Quiz1 |  | Class Room | |  |
| **Module 2** | **Trees and Basics of Graph Theory** | | | | |
| 14,15 | Introduction to Graph Theory and its applications to Computer Science  Types of Graphs, Sub Graphs, Some Operations on graphs | CO4 | Refer Blackboard, Suggested Reading | | Lecture |
| 16 | Isomorphism, Paths, Walks, Circuits,  Euler and Hamiltonian Graphs | CO4 | Refer Blackboard, Suggested Reading | | Lecture |
| 17 | Properties of Graphs, Cut Sets, Cut Vertices, | CO4 | Refer Blackboard, Suggested Reading | | Lecture |
| 18 | Weighted graphs, Shortest Path problem, Dijkstra’s algorithm | CO4 | Refer Blackboard, Suggested Reading | | Readings/ brief video/ Presentations |
| 19,20 | Trees-terminology, Representation, Types,  Spanning Trees, finding out the shortest spanning tree in a weighted graph (Prim’s and Kruskal’s Algorithm) | CO4 | Refer Blackboard, Suggested Reading | | Lecture |
| 21 | Cayley’s Theorem, Counting Spanning tree, Reflection & Discussion  Test - 1 | CO4, CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| **Module 3** | **Graph Theory and its Applications** | | | | |  |
| 22 | Concept of Planar graphs with introduction to Kuratowski’s non-planar graphs, Proof of Euler’s formula | CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| 23 | Detection of planarity , geometric duals of graph | CO4, CO5 | Refer Blackboard, Suggested Reading | |  |
| 24 | Matrix Representation of Graph, incidence matrix A(G) and its properties, Adjacency matrix representation of a graph and its various properties | CO4, CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| 25 | Quiz 2 |  |  | |  |
| 26 | Concept of Graph coloring of vertices of a graph, Welsh-Powell algorithm | CO4, CO5 | Refer Blackboard, Suggested Reading | |  |
| 27 | Chromatic number and its calculation, Chromatic Polynomial | CO4, CO5 | Refer Blackboard, Suggested Reading | |  |
| 28 | Chromatic Polynomial using Decomposition Theorem | CO4, CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| 29 | Network flows , Max Flow in Transport Network, Ford- Fulkerson Algorithm | CO4,  CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| 30 | Max –Flow, Min-cut Theorem. | CO4, CO5 | Refer Blackboard, Suggested Reading | | Lecture |
| 31 | Test-2 |  | Blackboard | |  |
| **Module 4** | **Vector algebra and Matrices Transformation** | | | | |
| 32 | Vector Space | CO3 | Refer Blackboard, Suggested Reading | | Lecture |
| 33 | Spanning Set | CO3 | Refer Blackboard, Suggested Reading | | Lecture |  |
| 34 | Introduction to Linear Transformations , Properties of Linear transformations, Properties of Linear transformations | CO3 | Refer Blackboard, Suggested Reading | | Lecture |  |
| 35 | Kernel of Linear Transformation, Image of Linear Transformation | CO3 | Refer Blackboard, Suggested Reading | | Lecture |  |
| 36 | Rank Nullity Theorem, Matrices of Composite Linear Transformation | CO3 | Refer Blackboard, Suggested Reading | | Lecture |  |

1. **SUGGESTED READINGS:**

**Text Book:**

1. Discrete Mathematics and its applications by Kenneth Rosen, McGraw Hill Publications.
2. Discrete Mathematics, by R. K. Bisht & H.S.Dhami Oxford University Press.

**Reference books:**

1. Discrete Mathematics and its Applications, Trembley and Manohar TMH publications.
2. Elementary Linear Algebra, 9th Edition by Howard Anton & Chris Rorres, published by wiley Publication.
3. Discrete Mathematics, Schaum’s outline, by Seymour Lipschutz, McGraw Hill Publication.
4. Graph Theory with its Applications, Narsingh Deo, PHI
5. **GUIDELINES:**

***Cell Phones and other Electronic Communication Devices*:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.

***E-Mail and online learning tool:*** Each student in the class should have an e-mail id and a password to access the ICOS/LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.

***Attendance:*** Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

***Passing criterion:*** .Student has to secure minimum 40% marks of the “highest marks in the class scored by a student in that subject (in that class/group class)” individually in both the ‘End-Semester examination’ and ‘Total Marks’ in order to pass in that paper.

1. **COURSE OUTCOME ASSESSMENT:**

To assess the fulfillment of course outcomes two different approaches have been decided. Degree of fulfillment of course outcomes will be assessed in different ways through direct assessment and indirect assessment. In Direct Assessment, it is measured through quizzes, tests, assignment, Mid-term and/or End-term examinations. It is suggested that each examination is designed in such a way that it can address one or two outcomes (depending upon the course completion). Indirect assessment is done through the student survey which needs to be designed by the faculty (sample format is given below) and it shall be conducted towards the end of course completion. The evaluation of the achievement of the Course Outcomes shall be done by analyzing the inputs received through Direct and Indirect Assessments and then corrective actions suggested for further improvement.

**Sample format for Indirect Assessment of Course outcomes**

|  |
| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes of Discrete Mathematical structures.

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No. | Course Outcomes | 1 | 2 | 3 | 4 |
| 1 | CO1. Understand and interpret the fundamental mathematical structures like Set theory, Relation and Functions |  |  |  |  |
| 2 | CO2. Write recursive definitions of sequences and collections of objects. |  |  |  |  |
| 3 | CO3: Understand the concepts and applications of vector algebra. |  |  |  |  |
| 4 | CO4. Understand and interpret the basic concepts of Graph Theory. |  |  |  |  |
| 5 | CO5: Apply the use of Graph theory concepts solving various Computer Science and Engineering problems |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2