



‘সমানো মন্ত্র: সমিতি: সমানী’

UNIVERSITY OF NORTH BENGAL
B.Sc. Honours Part-III Examination, 2022

MATHEMATICS
PAPER-XIV
NEW SYLLABUS

Time Allotted: 2 Hours

Full Marks: 50

*The figures in the margin indicate full marks.
All symbols are of usual significance.*

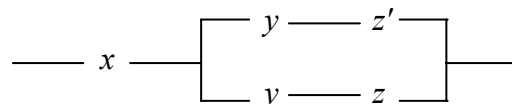
GROUP-A

1. Answer **all** questions:
 - (a) Define the degrees of freedom of a particle in motion in three-dimensional Euclidean space. 1
 - (b) What is conservation of linear momentum? 1
 - (c) Cite an example of kinematic constraints. 1

2. Answer any **three** questions: 4×3 = 12
 - (a) What are generalized coordinates? Obtain generalized coordinates for a simple pendulum executing the SHM about the position of equilibrium. 4
 - (b) Prove that the total kinetic energy of a system of particles about any point O is equal to the kinetic energy of the centre of mass assuming total mass acting at it plus the kinetic energy of motion about the centre of mass. 4
 - (c) Write the equation of constants in Cartesian co-ordinates for the dynamical system: A pair of Cartwheels of radius R , the center of which are connected by a rigid shaft of length ‘ l ’ is allowed to roll without slipping down an inclined that makes an angle ‘ α ’ with the horizontal. 4
 - (d) Define non-conservative force. Find the potential energy corresponding to the gravitational force. 4
 - (e) Deduce Galilean transformation from Newton’s Second Law. 4

GROUP-B

3. Answer any **two** questions: 2×2 = 4
 - (a) Let A be the set of positive integers ≤ 30 and multiples of 4. Let B be the set of positive integers ≤ 30 and multiples of 6. Find $|A \cup B|$. 2
 - (b) Find the Boolean function which represents the circuit and simplify, if possible: 2

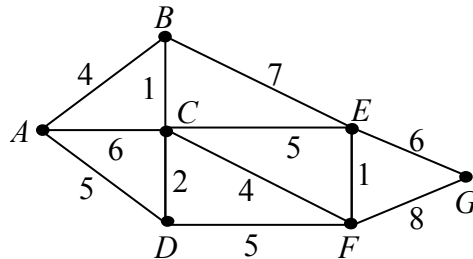


- (c) Find a closed form for the generating function $\{0, 0, 0, 1, 1, 1, 1, 1, \dots\}$. 2

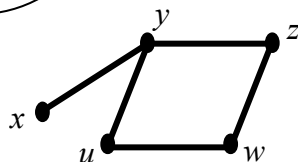
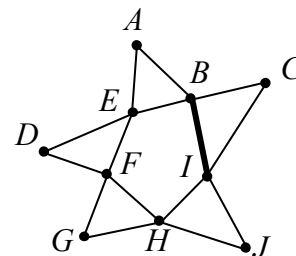
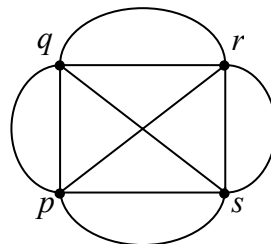
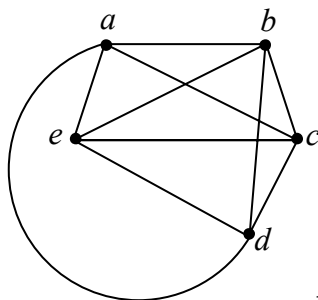
4. Answer any **four** questions: 4×4 = 16
- (a) Express the Boolean functions in both DNF and CNF of 4
 $f(x, y, z) = (x + y)(y + z)(z + x)$
- (b) If a, b, c be three switches then draw a switching circuit representing 4
 $(a + b' + c)(a + bc') + bc$ and simplify, if possible.
- (c) Prove that for a bounded distributive lattice L complements, if exist, are unique. 4
- (d) Write down dual of each statement: 4
 (i) $(a \wedge b) \vee c = (b \vee c) \wedge (c \vee a)$
 (ii) $(a \wedge b) \vee a = a \wedge (b \vee a)$.
- (e) Solve the recurrence relation $a_{n+2} - 3a_{n+1} + 2a_n = 0$ by the generating function 4
 method with initial conditions $a_0 = 2$ and $a_1 = 3$.
- (f) State Pigeonhole principle. Show that if any five members from 1 to 8 are chosen, 4
 then two of them will add to 9.

GROUP-C

5. Answer any **three** questions: 5×3 = 15
- (a) Prove that a graph is bipartite if and only if it contains no odd cycles. 5
- (b) Show that K_n is a planar graph for $n \leq 4$ and non-planar for $n \geq 5$. 5
- (c) If a simple regular graph has n vertices and 24 edges, find all possible values of n . 5
- (d) Find the minimal spanning tree in the following using Prim's algorithm: 5



- (e) From the following graphs, find a graph 5
 (i) having Euler's circuit, but not Hamiltonian circuit.
 (ii) having Hamiltonian circuit, but not Euler's circuit.



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