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M.A./M.Sc. Semester II Examination, 2019 (under DDE)

Subject: Mathematics

Paper: MCG 203

Time: 2 Hours Full Marks: 45

The figures in the margin indicate full marks.
Candidates are required to give their answers in their own words as far as practicable.
[Notation and symbols have their usual meaning]
Write the answer to Questions of each Group in separate books.

Group – A (Operations Research-II)

(Marks: 27)

Answer any **three** questions. Only **first three** answers will be evaluated. 9×3 = 27

1 (a) Derive the expressions for optimum order quantities for a multi-item EOQ model with average inventory constraint. [6]

(b) Find the optimum order quantity for a product for which the price breaks are as follows: [3]

Range of quantity to be purchased	Purchase cost per unit (Rs.)
$0 < Q < 100$	20.00
$Q \geq 100$	15.00

The monthly demand for the product is 400 units. The storage cost is 20% of the unit cost of the product and the cost of ordering is Rs. 25.00 per order.

2 (a) Discuss total float and free float of an activity of a project. [3]

(b) Activities and time estimates (in weeks) of a project are given in the following table: [6]

	Duration (in weeks)		
Activity	Optimistic	Most likely	Pessimistic
1-2	1	1	7
1-3	1	4	7
1-4	2	2	8
2-5	1	1	1
3-5	2	5	14
4-6	2	5	8
5-6	3	6	15

(i) Draw the project network.
(ii) Find the critical path and the expected project completion time.

3 (a) Sketch the Branch and Bound method to solve an all integer linear programming problem. [4]

(b) Solve the following all integer linear programming problem: [5]
Maximize $z = 3x_1 + 4x_2$
subject to $3x_1 + 2x_2 \leq 8$, $x_1 + 4x_2 \geq 10$, $x_1, x_2 \geq 0$ are integers.

4. (a) There are five jobs, each of which must go through machines A, B and C in [5]

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order ABC. Processing times (in hours) are given in the following table:

Machine	Job 1	Job 2	Job 3	Job 4	Job 5
A	8	10	6	7	11
B	5	6	2	3	4
C	4	9	8	6	5

Find the minimum elapsed time and idle time of each machine.

(b) Write down the expression for optimum order quantity of a purchasing inventory model with fully backlogged shortages. Hence find the optimum order quantity when the following situations occur: [4]
(i) shortage cost is negligible.
(ii) inventory carrying cost is negligible.
(iii) inventory carrying cost and shortage cost are equal.

5. (a) What are the basic differences between PERT and CPM? [2]

(b) The following table shows activities, their normal time, normal cost, crash time and crash cost for a project. [1+2+4]

Activity	Normal Time (days)	Normal cost (Rs.)	Crash time (days)	Crash cost (Rs.)
1-2	6	1400	4	1900
1-3	8	2000	5	2800
2-3	4	1100	2	1500
2-4	3	800	2	1400
3-4	Dummy	-	-	-
3-5	6	900	3	1600
4-6	10	2500	6	3500
5-6	3	500	2	800

Indirect cost for the project is Rs. 300 per day.
(i) Draw the network of the project.
(ii) What are the normal duration and the associated cost of the project?
(iii) Find the optimum duration and minimum project cost.

Group - B (Principle of Mechanics - II)

(Marks: 18)

Answer any **two** questions. Only **first two** answers will be evaluated. 9×2 = 18

1 (a) Obtain the expression of kinetic energy of a rigid body rotating about a fixed point of it. Show that in the absence of external force, kinetic energy of the body remains constant. [3+2]

(b) Prove that the steady motion of a top with vertical axis is stable. [4]

2 (a) A particle is projected vertically upwards with a velocity W from a point O on the earth's surface. Prove that, when it returns to the horizontal plane through O, it will have a westerly deviation. Also find the deviation (assume that the earth rotates [5]

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with a uniform angular velocity).

(b) For small oscillations of a conservative dynamical system of one degree of freedom, prove that the potential energy at the equilibrium position is minimum for stable motion and maximum for unstable motion. [4]

3 (a) Obtain the transformation formulae for velocity components of a particle from one inertial frame to another which are in uniform relative motion with respect to each other in the common x-direction. [5]

(b) Explain the phenomenon of time dilation in special theory of relativity. [4]