E 3874   (Pages : 3)   Reg. No............................

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B.Sc. DEGREE (C.B.C.S.S.) EXAMINATION, OCTOBER 2016

Third Semester

Complementary Course—OPERATIONS RESEARCH : QUEUING THEORY

(For Model II B.Sc. Mathematics)

[2013 Admission onwards]

Time : Three Hours   Maximum Marks : 80

Part A

Answer all questions.
Each question carries 1 mark.

1. Define a rectangular game.

2. Define the term Payoff.

3. Define the term saddle point.

4. Define the term independent float.

5. Define the terms merge event and burst event.

6. What do you mean by slack ?

7. What is a least cost schedule of a project ?

8. What do you understand by queue input ?

9. What is traffic intensity ?

10. Write the probability density function of an exponential distribution.

$(10 \times 1 = 10)$

Part B

Answer any eight questions.
Each question carries 2 marks.

11. What is a symmetric game ? Show that the value of a symmetric game is always zero.

12. Explain minimax strategy.

13. Examine the following payoff matrix for saddle points $\begin{bmatrix} 2 & -1 & -2 \\ 1 & 0 & 1 \\ -2 & -1 & 2 \end{bmatrix}$.

14. Explain the term pessimistic estimate used in PERT.

15. What do you mean by optimum project schedule ?

16. Explain the term Full PERT.

Turn over

17. Distinguish between Critical and Non-critical activities.

18. Explain the term CPM.

19. Explain the terms looping and dangling in networks.

20. What do you understand by queue discipline ?

21. State the components of a queue.

22. If the traffic intensity is 0.30. What is the percent of time a system remains idle ?

$(8 \times 2 = 16)$

Part C

Answer any **six** *questions.*
Each question carries 4 marks.

23. Solve graphically the game whose payoff matrix is $\begin{bmatrix} 2 & 7 \\ 3 & 5 \\ 11 & 2 \end{bmatrix}$.

24. For the game with the following payoff matrix (for A), determine the value of the game and the optimal mixed strategies for each player :

		B	
		I	II
A	I	2	5
	II	7	3

25. Explain max-min principle used in game theory.

26. Mention the areas of application of network techniques.

27. Draw the network given the following precedence relationships :

Event numbers :	1	2,3	4	5	6	7
Preceded by :	—	1	2,3	3	4,5	5,6

28. Explain the following in the context of project management :

(i) Project variance ; (ii) Activity variance.

29. What are the inherent limitations of network analysis ?

30. Discuss the fields of application of queuing theory.

31. Arrivals at a telephone booth are considered to be Poisson with an average time of 10 minutes between one arrival and the next. The length of the phone call is assumed to be distributed exponentially with mean 3 minutes. What is the probability that a persons arriving at the booth will have to wait ?

$(6 \times 4 = 24)$

Part D

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

32. (a) Use the notion of dominance to simplify the following payoff matrix and solve the game :

$$\begin{bmatrix} 0 & 0 & 0 & 0 & 0 \\ 4 & 2 & 0 & 2 & 1 \\ 4 & 3 & 1 & 3 & 2 \\ 4 & 3 & 4 & -1 & 2 \end{bmatrix}.$$

(b) Write both the primal and the dual LP problems corresponding to the game with payoff matrix given below. Solve the game by solving the LP problem :

$$\begin{bmatrix} 1 & -1 & 3 \\ 3 & 5 & -3 \\ 6 & 2 & -2 \end{bmatrix}.$$

33. Draw the network diagram for a project consisting of 12 tasks (A, B, − − − L) in which the following precedence relationship must hold. (X < Y means X must be completed before Y can start) ; A < C, A < B, B < D, B < G, B < K, C < D, C < G, D < E, E < F, F < H, F < I, F < L, G < L, H < J, I < J, K < L. Given the following task times for the above project, locate the critical path :

Task :	A	B	C	D	E	F	G	H	I	J	K	L
Time :	30	7	10	14	10	7	21	7	12	15	30	15

Also find the free and total floats for non-critical activities.

34. Patients arrive at a clinic according to a Poisson distribution at the rate of 30 patients per hour. The waiting room does not accommodate more than 14 patients. Examination time per patient is exponential with mean rate 20 per hour.

    (i) Find the effective arrival rate at the clinic.

    (ii) What is the probability that an arriving patient will not wait ? Will he find a vacant seat in the room.

    (iii) What is the expected waiting time until a patient is discharged from the clinic ?

35. Define the concept of busy period in queuing theory and its distribution for the system (M|M|1:∞|FCFS). Obtain expression for average length of busy period. Describe a queue model and steady-state equations for M|M|1 queues. What is the probability that atleast one unit is present in the system.

$$(2 \times 15 = 30)$$