BITS, PILANI – DUBAI

DUBAI INTERNATIONAL ACADEMIC CITY

(III YEAR – II SEMESTER 2010-2011)

COMPREHENSIVE EXAMINATION (CB)

OPERATIONS RESEARCH
(AAOC C 312)

Max. Marks: 120 Weightage: 40% Date: 06-06-2011 Time: 3 Hours

- SECTION-A, SECTION-B and SECTION-C should be answered in separate answer books.
- Attempt the questions in sequential order.
- Non-programmable calculator is permitted
- Necessary ***statistical table*** *values* are given on the last page

SECTION- A

1. An automobile firm requires 1000 bolts of a particular type every day. Shortage cost is estimated to be Rs 2 per hundred bolts per day and holding cost is Rs 1 per hundred bolts per day. The firm can either manufactures the bolts or purchase them from an outside source. The setup cost is Rs 500 for manufacturing and Rs 50 for purchasing. The unit cost per hundred bolts is Rs 20 if purchased and Rs. 10 if manufactured. While the manufacturing rate is 6000 bolts per day, the delivery is instantaneous if the firm purchases from the source. What should be the policy of the firm: to manufacture or to purchase? [10]

2. Following are the samples taken from two populations which are not independent of each other.
   Sample I : 72 82 93 65 76 89 81 58 95 91
   Sample II: 75 79 84 71 82 91 85 68 90 92
   Investigate the claim that the mean of population-I is higher than that of population-II at $\alpha = 0.05$. [10]

3. 30 plots of approximately equal fertility were sown with 5 different varieties of wheat: A, B, C, D, E. The assignment of plots to varieties was random. The following table gives the yields in quintals per acre. Assume that climatic conditions are almost the same at all plots. Do the data indicate a significant difference in the yields of the varieties at 5 percent level of significance?
   A: 13, 10, 11, 16, 12, 15
   B: 11, 13, 18, 12, 14
   C: 10, 12, 13, 11, 14
   D: 10, 15, 17, 10, 17, 15, 11
   E: 14, 19, 12, 15, 9, 13, 14 [10]

4. A paired design produced the following responses.

Pair No :	1	2	3	4	5	6	7	8	9	10	11
Program A:	90,	70,	60,	50,	52,	75,	40,	38,	36,	23,	21
Program B:	20,	40,	40,	42,	52,	65,	25,	40,	37,	26,	25.

   It is claimed that Program A is superior to program B. Use *Wilcoxon's signed rank Sum* test to decide whether the claim is true. Use $\alpha = 5\%$. [10]

5. The following data are given for 20 samples of size 4 each

Sample	1	2	3	4	5	6	7	8	9	10
$\hat{\sigma}_j$	3	0.5	1.2	4	2.8	1.2	0.9	1.4	1.2	1.6

Sample	11	12	13	14	15	16	17	18	19	20
$\hat{\sigma}_j$	1.2	1.0	1.3	0.7	2	2.8	1.2	4.2	2.8	2.6

a) Use these data to find the central line and control limits for a σ chart. (*up to three decimal places*).
b) Draw the σ chart (*Draw in answer book, graph paper is not required*).
c) Is the process under control? [10]

6. Use *Kolmogorov-Smirnov* test with $\alpha = 5\%$ to determine whether following data could have come from uniform distribution on [2,4]

2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6. [10]

SECTION- B

7. An experiment is carried out to compare four additives (A, B, C and D) for reducing NOX emissions from cars. Four drivers (I, II, III and IV) and four cars (1, 2, 3 and 4) are used in the experiment. Because there may be significant driver effects and car effects, we would like to block on both variables. A Latin Square design is used. The following table shows the reduction in emission in this Latin Square design:

Drivers \ Cars	1	2	3	4
I	A(21)	B(26)	D(20)	C(25)
II	D(23)	C(26)	A(20)	B(27)
III	B(15)	D(13)	C(16)	A(16)
IV	C(17)	A(15)	B(20)	D(20)

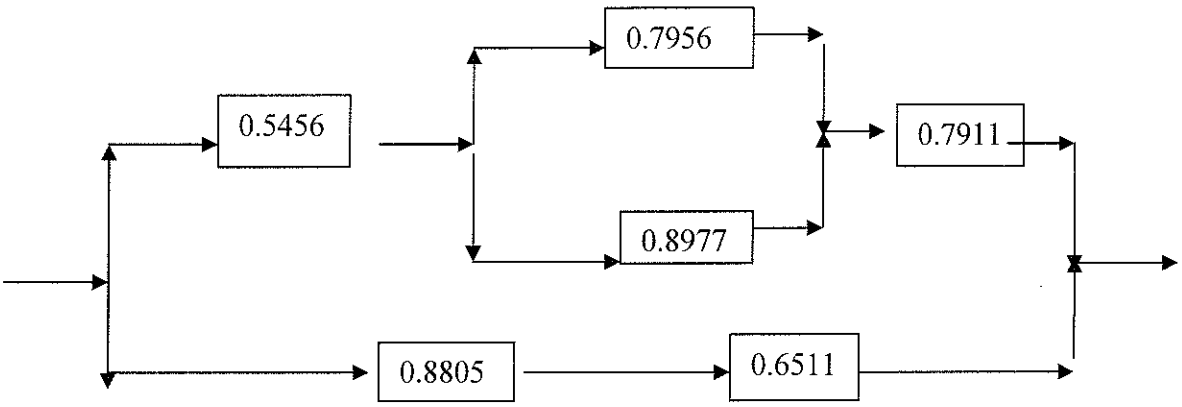
a) Construct the ANOVA table for this Latin Square design.
b) What is the critical region at 1% level of significance?
c) Test at 1% level of significance whether there is any significant difference among four additives for reducing NOX emissions. [10]

8. The random variable X has exponential distribution with parameter λ. Suppose it is required to test the null hypothesis $H_0 : \lambda = 0.1$ against the alternative $H_1 : \lambda = 0.05$. A random sample of size 15 is drawn. The sample values are: 15, 18, 12, 14, 16, 18, 10, 16, 19, 13, 20, 16, 18, 14, 19.
   a) What is the critical region of the test at 5% level of significance?
   b) What is the observed value of the test statistic?
   c) Can we reject H_0 at 5% level of significance? Justify. [10]

9. One two-wheeler manufacturing company experienced irregular but usually increasing demand for their bikes. The demand was found to be 420 bikes for June and 440 bikes for July, 450 for August, 500 for September and 550 for October. Use exponential smoothing technique to forecast the sale for the November taking smoothing constant $\alpha = 0.4$. Calculate MAD. [10]

SECTION- C

10. Find the reliability of the system connected as below where the numbers inside the boxes indicate the reliabilities of the corresponding components. Assume that the components function independently. *In all steps at least 5 decimal places must be considered*: [10]



11. A parking lot has 5 parking spaces of cars. Cars arrive, for parking at the lot, in Poisson process at the rate of 8 cars per hour. The parking time of a car is exponentially distributed with a mean of 30 minutes. When all the 5 parking spaces are occupied, then any car that arrives goes elsewhere for parking.
    (a) What fraction of cars, are lost as customers to this parking lot, i.e. go elsewhere for parking?
    (b) Find the mean number of cars parked at the lot. [10]

12. A company has appointed three salesmen A, B and C and observed their sales in three seasons – summer, winter and monsoon. The figures (in millions of Dhs) are given in the following table:

	Seasons		
Salesmen	Summer	Winter	Monsoon
A	35	15	10
B	20	32	18
C	15	33	22

Given that the inputs to the three salesmen are of the same standard. Test the null hypothesis that the three salesmen are equally good. Use $\alpha = 0.05$. [10]

TABLE VALUES AS PER STANDARD NOTATION:

$\chi^2_{4;0.95} = 9.488$, $\chi^2_{5;0.95} = 11.071$, $\chi^2_{30;0.95} = 43.773$

$F_{3,6;0.99}$= 9.78, $F_{4,24;0.95}$= 2.7763, $F_{4,25;0.95}$= 2.7587, $t_{9,0.95}$=1.833, $D_{8,0.05}$=0.454,

For n=4; B_3=0, B_4= 2.266

For n=10,

X	P	X*
45	0.042	10
46	0.032	9

For n =11

X	P	X*
53	0.042	13
54	0.034	12

For, (M/M/s) : (FCFS/m/∞) [m≥s] model,

1) $P_n = \dfrac{\rho^n}{n!} P_0, \quad n = 0,1,\ldots,(s-1)$

$= \dfrac{\rho^n}{s!\,s^{n-s}} P_0, \quad n = s, s+1, \ldots, m$

$= 0, \quad n = m+1, m+2, \ldots$

where $P_0 = \dfrac{1}{1 + \rho^s \dfrac{\left\{1 - \left(\dfrac{\rho}{s}\right)^{m-s+1}\right\}}{s!\left(1 - \dfrac{\rho}{s}\right)} + \sum_{n=1}^{s-1} \dfrac{\rho^n}{n!}}, \quad \dfrac{\rho}{s} \neq 1$

$$= \frac{1}{1 + \dfrac{s^s}{s!}(m-s+1) + \sum_{n=1}^{s-1} \dfrac{\rho^n}{n!}}, \quad \frac{\rho}{s} = 1$$

2) $L_q = \dfrac{\rho^{s+1}}{s!\,s}\left[\dfrac{1-(m-s+1)U^{m-s} + (m-s)U^{m-s+1}}{(1-U)^2}\right] P_0$ when $U = \dfrac{\rho}{s} \neq 1$

$= \dfrac{s^s}{s!}\dfrac{(m-s)(m-s+1)}{2} P_0$ when $U = \dfrac{\rho}{s} = 1.$

3) $L = L_q + (1 - P_m)\rho.$

4) $\overline{\lambda} = \lambda(1 - P_m)$.

BITS, PILANI – DUBAI CAMPUS
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(III YEAR – II SEMESTER 2010-2011)

TEST– II (OB)

COURSE: OPERATIONS RESEARCH **COURSE NO.: AAOC C 312**
Max. Marks: 60 Weight age: 20% Date: 24.04.11 Time: 50 Minutes

NOTE:
- Prescribed text book i.e. EDD notes and handwritten class notes are allowed.
- Attempt all the questions.

1. A tax consulting firm has three counters in its office to receive people who have problems concerning their income, wealth and sales tax. On the average 48 persons arrive in 8 hour day. Each tax adviser spends 15 minutes on the average on an arrival. The arrivals and service times follow Poisson and exponential distribution respectively. Find
   a) The number of hours each day a tax adviser spends performing his job.
   b) Average number of customers waiting to be served.
   c) The probability that two tax advisers are idle. [9]

2. On the average 96 patients per 24- hour day require the service of an emergency clinic. Also on the average, a patient requires 10 minutes of active attention. Assume that the facility can handle only one emergency at a time. Suppose that it costs the clinic Rs100 per patient treated to obtain on average servicing time of 10 minutes, and that each minute in this average time would cost the clinic Rs.10 per patient treated. How much would have to be budgeted by the clinic to decrease the average size of the queue from $^4/_3$ patients to $^1/_2$ patient? [15]

3. The manager of a large production facility believes that worker productivity is a function of, among other things, the design of the job, which refers to the sequence of worker movements. Two designs are being considered for the production of a new product. To help decide which should be used, an experiment was performed. Six randomly selected workers assembled the product using design A and other eight workers assembled the product utilizing design B. The assembly times, in minutes, were recorded and are exhibited below. Assuming that the assembly times are normally distributed and both the populations have unknown but equal variances; can the manager conclude at 5% significance level that the average assembly times differ for the two designs?
   Design A: 8.2, 5.3, 6.5, 5.1, 9.7, 10.8
   Design B: 9.5, 8.3, 7.5, 10.9, 11.3, 9.3, 8.8, 8.0 [15]

4. A manufacturer of a bottle-filling machine claims that the standard deviation of the fills from his machine is less than 2 cc. In a random sample of 10 fills, the sample standard deviation was 1.19 cc. Is this sufficient evidence at the 5% level of significance to support the manufacturer's claim? (Assume a normal population). [6]

5. The number of arrivals of customers to a bank were recorded per minute for 200 one minute periods and the following results were obtained.

No. of arrivals:	0	1	2	3	4	5	6	7	8
Frequency :	14	31	47	41	29	21	10	5	2

Does a Poisson distribution fit the data well? Use Chi-Square test of goodness of fit at 5 percent level of significance. [15]

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BITS, PILANI – DUBAI
INTERNATIONAL ACADEMIC CITY, DUBAI
(III YEAR – II SEMESTER 2010-2011)

TEST– I (CB)

COURSE: OPERATIONS RESEARCH **COURSE NO.: AAOC C 312**
Max. Marks: 75 Weightage: 25% Date: 06.03.11 Time: 50 Minutes

Attempt all the questions.

1) The demand of an item is 225 units per day and production rate is 450 units per day . The cost of holding inventory is Rs. 2 per item per day. The back ordering is allowed at the cost of Rs. 2 per item per day. The cost of starting a production run is Rs 100 per run. The per unit production cost is as follows:

Rs. 4 if $Q < 200$
Rs. 3.5 if $200 \leq Q < 500$
Rs. 3 if $Q \geq 500$

Determine optimal order cycle (OOC) t_0^*. [20]

2) A company has to supply the cornflakes packets of a specified weight in the market. Ten samples of size 5 each were examined and the following results were obtained:

Sample No.	: 1	2	3	4	5	6	7	8	9	10
Mean	: 430	435	425	434	435	425	430	430	438	435
Range	: 2	1	5	7	3	4	8	6	10	6

(i) Use the above data to find the central line, upper control limit and lower control limit of $\overline{X}$ - chart.

(ii) Draw the $\overline{X}$ control chart and specify if the process is under control. [15]
(Plot the control chart on the answer book, graph paper is not required)

3) (i) The following table shows the actual demand for 6 months:

Month	Jan.	Feb.	Mar.	Apr.	May	Jun.
Demand (in thousand $)	45	60	72	58	40	48

Find 4-month weighted moving average forecast for the demand for July. Assign weights 0.1, 0.2, 0.3, 0.4 to Mar., Apr., May, Jun. respectively.

(ii) Sunrise sports have experienced rapidly expanding retail sales. Its sales levels for the past 5 months are:

Month	1	2	3	4	5
Sales (in million $)	1.9	3.1	2.8	4.5	5.8

Use exponential smoothing technique to forecast the sale for the 6th month. Take smoothing constant $\alpha = 0.4$. [20]

4) A production firm uses a particular raw material at the rate of 5000 Kgs per month. Cost of placing an order is AED 200 and holding cost per Kg per month is AED 4. The shortage cost per Kg is AED 5. Past data indicate that the demand during lead time follow Uniform distribution over the range (0, 50).
Determine the Optimal ordering quantity and Optimal reorder level inventory (Calculate values only up to three iterations) [20]

TABLE VALUES: As per the standard notation:

For n = 5: $A_1 = 1.596, A_2 = 0.577$

For n = 10: $A_1 = 1.028, A_2 = 0.908$

A

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-II (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 21 | Weightage: 7% | Date: 11-05-2011 | Time: 20 Minutes

Name:

Id No.: **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. In the test for independence of two characteristics, the contingency table consists of 5 rows and 4 columns. The degrees of freedom of the chi-square test statistics is _____ .

2. Which of the following is NOT CORRECT for Wilcoxon Signed Rank Sum test?

   a. Nonparametric procedures require fewer assumptions than parametric procedures.
   b. The SIGNED-RANK SUM test should be used for paired data.
   c. Nonparametric procedures can be used with ordinal data since all that is needed are the relative sizes of the values.
   d. Tied values are assigned a rank equal to average of the ranks associated with the tied values.

   (i) a (ii) c (iii) All of the above (iv) None of the above

3. The non- parametric tests of goodness of fit are
   (i) Sign test (ii) Kolmogorov – Smirnov test (iii) X^2 – test (iv) Wilcoxon Rank sum test

   (a) ii & iii (b) i & iv (c) ii , iii & iv (d) All of the above

4. A sample of 50 families with five children each gave the following result

Male Child:	0	1	2	3	4	5
No. of families:	5	7	8	12	10	8

   Assuming that the above data is consistent with the hypothesis that male and female births are equally likely, then observed frequencies $O_1 =$ _____ and $O_2 =$ _____

5. To test the hypothesis whether a given data of 40 observations have come from Normal distribution, the χ^2 test for the goodness of fit is used. If the number of observations in each cell is 5, then degree of freedom of χ^2 statistics is _____

6. If (2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6) be a random sample from a uniformly distributed population on [2, 4] then $(F_8(3.9)) =$ _____ and $(F_0(3.9)) =$ _____ as per Kolmogorov-Smirnov test procedure.

7. The differences for the given set of observations $(x_i\ y_i)$ are 2,0,0,1,2,2,3,-3,1,2,3,0,-1,1,-2,1. If Wilcoxon's signed rank-sum test is used, the number of differences with the final rank 8 is _____ and the observed value of T^+ is _____.

A

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-II (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 21 | Weightage: 7% | Date: 11-05-2011 | Time: 20 Minutes

Name:

Id No.: **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. In the test for independence of two characteristics, the contingency table consists of 6 rows and 5 columns. The degrees of freedom of the chi-square test statistics is _____ .

2. Which of the following is NOT CORRECT for Wilcoxon Signed Rank Sum test?

   a. Nonparametric procedures require fewer assumptions than parametric procedures.
   b. The SIGNED-RANK SUM test should be used for paired data.
   c. Nonparametric procedures can be used with ordinal data since all that is needed are the relative sizes of the values.
   d. Tied values are assigned a rank equal to average of the ranks associated with the tied values.

   (i) a (ii) c (iii) None of the above (iv) All of the above

3. The non- parametric tests of goodness of fit are
   (i) Sign test (ii) Kolmogorov – Smirnov test (iii) X^2 – test (iv) Wilcoxon Rank sum test

   (a) i & iii (b) i , ii & iv (c) ii , iii (d) All of the above

4. A sample of 50 families with five children each gave the following result

Male Child:	0	1	2	3	4	5
No. of families:	5	5	10	12	10	8

   Assuming that the above data is consistent with the hypothesis that male and female births are equally likely, then observed frequencies $O_1 =$ _____ and $O_2 =$ _____

5. To test the hypothesis whether a given data of 50 observations have come from Normal distribution, the χ^2 test for the goodness of fit is used. If the number of observations in each cell is 5, then degree of freedom of χ^2 statistics is _____

6. If (2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6) be a random sample from a uniformly distributed population on [2, 4] then $(F_8(3.5))$ = _____ and $(F_0(3.5))$ = _____ as per Kolmogorov-Smirnov test procedure.

7. The differences for the given set of observations $(x_i\ y_i)$ are -2,0,0,1,2,2,3,-3,1,2,3,0,-1,1,-2,1. If Wilcoxon's signed rank-sum test is used, the number of differences with the final rank 3 is _____ and the observed value of T^+ is _____.

B

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-II (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 21 | Weightage: 7% | Date: 11-05-2011 | Time: 20 Minutes

Name:

Id No.: **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. In the test for independence of two characteristics, the contingency table consists of 8 rows and 5 columns. The degrees of freedom of the chi-square test statistics is _____ .

2. Which of the following is NOT CORRECT for Wilcoxon Signed Rank Sum test?

   a. Nonparametric procedures require fewer assumptions than parametric procedures.
   b. The SIGNED-RANK SUM test should be used for paired data.
   c. Nonparametric procedures can be used with ordinal data since all that is needed are the relative sizes of the values.
   d. Tied values are assigned a rank equal to average of the ranks associated with the tied values.

   (i) a (ii) c (iii)All of the above (iv)None of the above

3. The non- parametric tests of goodness of fit are
   (i) Sign test (ii) Kolmogorov – Smirnov test (iii) X^2 – test (iv) Wilcoxon Rank sum test

   (a) i & iii (b) iii & iv (c) i, ii & iii (d) None of the above

4. A sample of 50 families with five children each gave the following result

Male Child:	0	1	2	3	4	5
No. of families:	5	7	10	7	12	9

   Assuming that the above data is consistent with the hypothesis that male and female births are equally likely, then observed frequencies $O_1 =$ _____ and $O_2 =$ _____

5. To test the hypothesis whether a given data of 60 observations have come from Normal distribution, the χ^2 test for the goodness of fit is used. If the number of observations in each cell is 5, then degree of freedom of χ^2 statistics is _____

6. If (2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6) be a random sample from a uniformly distributed population on [2, 4] then $(F_8(2.8)) =$ _____ and $(F_0(2.8)) =$ _____ as per Kolmogorov-Smirnov test procedure.

7. The differences for the given set of observations $(x_i\ y_i)$ are 2,0,0,-1,2,-2,3,-3,2,2,3,0,2,1,-2,1. If Wilcoxon's signed rank-sum test is used, the number of differences with the final rank 12 is _____ and the observed value of T^+ is _____.

B

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-II (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 21 | Weightage: 7% | Date: 11-05-2011 | Time: 20 Minutes

Name:

Id No.: **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. In the test for independence of two characteristics, the contingency table consists of 7 rows and 5 columns. The degrees of freedom of the chi-square test statistics is _____ .

2. Which of the following is NOT CORRECT for Wilcoxon Signed Rank Sum test?

   a. Nonparametric procedures require fewer assumptions than parametric procedures.
   b. The SIGNED-RANK SUM test should be used for paired data.
   c. Nonparametric procedures can be used with ordinal data since all that is needed are the relative sizes of the values.
   d. Tied values are assigned a rank equal to average of the ranks associated with the tied values.

   (i) a (ii) c (iii) None of the above (iv) All of the above

3. The non- parametric tests of goodness of fit are
   (i) Sign test (ii) Kolmogorov – Smirnov test (iii) X^2 – test (iv) Wilcoxon Rank sum test

   (a) i & iii (b) ii & iii (c) i, ii & iii (d) All of the above

4. A sample of 50 families with five children each gave the following result

Male Child:	0	1	2	3	4	5
No. of families:	5	7	10	8	12	8

   Assuming that the above data is consistent with the hypothesis that male and female births are equally likely, then observed frequencies $O_1 =$ _____ and $O_2 =$ _____

5. To test the hypothesis whether a given data of 30 observations have come from Normal distribution, the χ^2 test for the goodness of fit is used. If the number of observations in each cell is 5, then degree of freedom of χ^2 statistics is _____

6. If (2.5, 2.1, 3.4, 2.3, 2.8, 3.5, 3.9, 2.6) be a random sample from a uniformly distributed population on [2, 4] then $(F_8(3.4))$ = _____ and $(F_0(3.4))$ = _____ as per Kolmogorov-Smirnov test procedure.

7. The differences for the given set of observations $(x_i\ y_i)$ are 2,0,0,-1,2,2,3,-3,2,2,3,0,2,1,-2,1. If Wilcoxon's signed rank-sum test is used, the number of differences with the final rank 7 is _____ and the observed value of T^+ is _____.

A

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-I (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 24 | Weightage: 8% | Date: 30-3-2011 | Time: 20 Minutes

Name: **Id No.:** **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. If in a (M/M/1):(FCFS /3/$\propto$) queuing system, the mean arrival rate is 7 per hour and the probability that there are 3 customers in the system is 0.15, then the mean effective arrival rate is _____
2. If the moment generating function of a random variable X is $M_X(t) = e^{3(e^t-1)}$,
   (i) the name of the distribution of X is _____
   (ii) the value of its parameter is _____ .
3. In a (M/M/s)/(FCFS/$\propto$/$\propto$) queueing model, the mean arrival rate is 15 customers per hour and the mean service time for a customer is 10 customers per hour. To avoid infinite queue, the minimum number of servers required is _____ .
4. If Z~N(0,1) , then Z^2 follows _____ distribution.
5. The probability distribution for which the moment generating function does not exist is
   (a) Cauchy (b) Gamma (c) Pascal (d) Binomial (e) Geometric
6. Let X is a normal variate with mean 20 and variance 10. If $Y = 4X + 5$, then the distribution of Y is also normal with mean _____ and variance _____ .
7. In a self-service queuing model, mean arrival rate is 8 per hour and the mean service rate is 4 per hour. The expected number of customers in the system is L = _____
8. If in a (M/M/3):(FCFS /5/5) queuing system, the mean arrival rate is 7 per hour and the probability that there are 5 customers in the system is 0.25, then the fraction of customers lost is _____ .

A1

BITS PILANI – DUBAI CAMPUS

Dubai International Academic City

III Year – II Semester

QUIZ-I (CB)

Course: Operations Research | Course No. AAOC C312

Max marks: 24 | Weightage: 8% | Date: 30-3-2011 | Time: 20 Minutes

Name: **Id No.:** **Sec:**

Attempt all the questions. Each question carries 3 marks. No marks will be awarded for overwriting/multiple answers. Do not use pencil. Do rough works on the back side of the question paper.

1. If in a (M/M/1/)/:(FCFS /5/∝) queuing system, the mean arrival rate is 7 per hour and the probability that there are 5 customers in the system is 0.25, then the mean effective arrival rate is _____
2. If the moment generating function of a random variable X is $M_X(t) = e^{4(e^t-1)}$,
   (i) the name of the distribution of X is _____
   (ii) the value of its parameter is _____ .
3. In a (M/M/s)/(FCFS/∝/∝) queueing model, the mean arrival rate is 25 customers per hour and the mean service time for a customer is 10 customers per hour. To avoid infinite queue, the minimum number of servers required is _____ .
4. If Z~N(0,1) , then Z^2 follows _____ distribution.
5. The probability distribution for which the moment generating function does not exist is
   (a) Exponential (b) Gamma (c) Cauchy (d) Binomial (e) Geometric
6. Let X is a normal variate with mean 20 and variance 10. If $Y = 2X + 5$, then the distribution of Y is also normal with mean _____ and variance _____ .
7. In a self-service queuing model, mean arrival rate is 10 per hour and the mean service rate is 4 per hour. The expected number of customers in the system is L = _____
8. If in a (M/M/3/)/:(FCFS /5/5) queuing system, the mean arrival rate is 7 per hour and the probability that there are 5 customers in the system is 0.35, then the fraction of customers lost is _____ .