BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Second Semester (2022-23)
Part-A

Course No. CE G520 Course Title: Infrastructure Planning & Management
Duration: 60 min. Maximum Marks: 40

Q.1 Choose the best alternative. **[10]**

i)Which of the following is/are a component(s) of Decision support System (DSS)?

A) user interface B) Knowledge base

a) Neither A or B b) only A c) only B d) Both A & B

ii) Which of the following is a good characteristic of a DSS?

a) It has an increment model
b) Responds quickly to decision makers to help in decision making
c) Automates decision making process
d) None of the mentioned above

iii)A Decision Support System (DSS) is an application for information systems that helps in ___

a) System Design
b) System Analysis
c) Decision making
d) All of the mentioned above

iv)DSS is most widely used in the ___, analysis in an organization.

a) Planning
b) Support
c) System maintenance
d) All of the mentioned above

v)Annie invests an amount of 6000 dollars for a period of 5 years. What is the value of the investment at the end of the given period if the investment earns a return of 5% compounded quarterly?

a) $ 1692 b) $ 7292 c) $7692 d) $7992

vi) Calculate the difference between four year and three-year moving average forecast for 2020.

Year	2015	2016	2017	2018	2019
Demand	55	60	58	65	72

a) 1.05 b) 1.13 c) 1.20 d) 1.25

vii) The table presents demand of a product. By simple three month moving average method, the demand forecast for the month of September will be

Month	Jan	Feb	March	April	May	June	July	August
Demand	450	440	460	510	520	495	475	560

a) 496.67 b) 510 c) 530 d)536.57

viii) An uninterrupted flow of production means:

a) Low-cost b) Efficient machines

c) Repair and maintenance d) Cost incurred

ix) Suppose you use regression to predict the height of a woman's current boyfriend by using her own height as the explanatory variable. Height was measured in feet from a sample of 100 women undergraduates, and their boyfriends, at ABC University. Now, suppose that the height of both the women and the men are converted to centimetres. The impact of this conversion on the slope is

a) the sign of the slope will change b) the magnitude of the slope will change

c) both a and b are correct d) neither a nor b are correct

x) The relationship between number of beers consumed (x) and blood alcohol content (y) was studied in 16 male college students by using least squares regression.

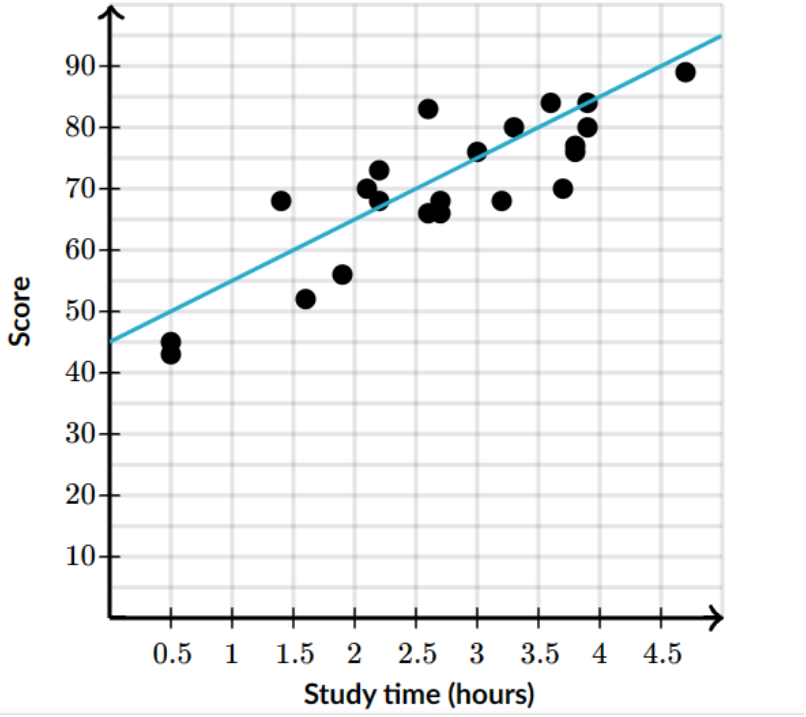
The following regression equation was obtained from this study: y= -0.0127 + 0.0180x

Suppose that the legal limit to drive is a blood alcohol content of 0.08. If Ricky consumed 5 beers the model would predict that he would be:

a) 0.09 above the legal limit b) 0.0027 below the legal limit

c) 0.0027 above the legal limit d) 0.0733 above the legal limit

Q.2 Shira's math test included a survey question asking how many hours students spent studying for the test. The scatter plot below shows the relationship between how many hours students spent studying and their score on the test. A line was fit to the data to model the relationship. **[5]**



Write linear equation to describe the model and based on the equation, estimate the score of a student that spent 5 hours of studying.

Q.3 company receives an order from a customer for 1,000 units of a green widget for $12 each. The company controller looks up the standard cost for a green widget and finds that it costs the company $14. Of the $14, $11 is variable cost and $3 is fixed cost. Should company accept this order? **[2]**

Q.4 Match the following: **[4]**

Type	Definition	Cost to implement	Disadvantage
a) Reactive	i) Investigation of failure modes to determine best maintenance strategy	A. high	1) Without optimization PM Creep can occur
b) Preventive	ii) Condition based monitoring triggering work orders	B. Average	2) Can lead to runway repair cost
c) Predictive	iii) Fix it when it breaks	C. Low	3) Requires Time, skill and financial resources to be effective
d) RCM	iv) Maintenance on predetermined schedule	D. Highest	4) Can be expensive to set up

Q.5 What are the disadvantages of Decision support system? **[3]**

Q.6 Manya wants to take admission to an engineering university. She estimates the total expenditure of her education would be around 50,000 dollars at the end of 4 years. Therefore, she wants to invest 5000 dollars within the said period and compounded quarterly. How much interest rate should Mia look for her investment so that she can return 50,000 dollars? **[6]**

Q.7 A second airport needs to be constructed at Delhi. There are three selected sites. The four main evaluation factors for the site selection are-environment, access, airport operation, and cost. The factor and sub factor weight of the main site evaluative parameters are given in **Table 1**. Rank the three sites based on their factor ranking. **[5]**

Table 1

Factors/sub-factors	**Factor weight**	**Sub factor weight**	**Site A**	**Site B**	**Site C**
1. Environment	31.5				
1.1 Air quality		4.2	3.8	2.1	2
1.2 Population displaced		2.3	4.5	4	3.7
1.3 Existing noise incompatible land use		6.3	2.9	5.4	3.4
1.4 Flood risk		4.1	6	4	10
2. Access	21.9				
2.1 General aviation market		2.8	8.9	6	8.1
2.2 Private vehicle accessibility		4.7	2.7	4	3.6
2.3 Public transport accessibility		3.8	10	9.2	8
3. Airport operations	31.3				
3.1 Airspace		4.2	7.4	6.4	7.8
3.2 Wind coverage		3.2	6	6.4	6.8
3.3 Other meteorological conditions		4.8	3	5.1	4
3.4 Site flexibility		2.5	5.8	9	8.2
4. Capital cost	15.3				
4.1 Present value of savings relative to most expensive sites		1	4	5.2	1.8

Q.8 The **Table 2** shows distribution of different travel mode in an area considered for Environmental Impact Assessment. Calculate the CO_2 emission in kg/year for different travel mode and rank the different travel mode from highest to lowest CO_2 emission annually. The data needed are provided in Table 2. Density of gasoline is 0.75 kg/L. CO_2 emission for 1 kg of gasoline combustion is 3 kg. **[5]**

Table 2

Travel mode	Total travel (million-km/year)	Fuel efficiency (L/km)
		Gasoline
Motorcycle	1000	0.025
Car	800	0.15
Truck	650	0.48
Bus	200	0.54

BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
Second Semester (2022-23)
Part-B(Open Book)

Course No. CE G520 Course Title: Infrastructure Planning & Management
Duration: 120 min. Maximum Marks: 80

Q.1 a) Rs. 1 crore facility will require replacement in twenty years. How much amount should be placed in the account yielding 7% interest, at the end of each year of the twenty years, in order to accumulate the Rs 2 Crore that is estimated to be needed for replacement? **[3]**

b) A Rs. 4 crore project taking four years to construct is financed by Rs.1 crore at the beginning of each year of construction. How much is owed at the end of construction? What annual net income is required to repay these costs over a twenty-year operating period? Assume 7 % interest rate. **[6]**

Q.2 Monthly sale revenue are available for the 9 months are given in table below. Based on these 9 values, a forecast has to be made for 10^{th}, 11^{th} and 12^{th} months. Similarly, forecast for the month ahead has to be made using the actual data that becomes available at the end of the 10^{th}, 11^{th} and 12^{th} month. Finally the best value of N(number of months) should be chosen to make the forecast for the 13^{th} month. **[20]**

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
Sales $000	125	145	186	131	151	192	137	157	198	143	163	204

Q.3 a) Complete the table: **[4]**

	Variable cost	Fixed Cost
Definition		
When production increases		
When production decreases		
Examples		

b) Tick the appropriate column [4]

Cost	Variable	Fixed
Depreciation of executive jet		

Cost of shipping finished goods to customers		
Wood used in manufacturing the furniture		
Sales manager salary		
Electricity used in manufacturing the furniture		
Packing supplies for shipping products		
Sand used in manufacturing concrete		
Supervisor's salary		
Advertising cost		
Executives' life insurance		

c) The Party Connection prepares complete party kits for various types of celebrations. It is currently operating at 75% of its capacity. It costs The Party Connection $4.50 to make a packet that it sells for $25.00. It currently makes and sells 84,000 packets per year. Detailed information follows:

	Per Unit	*Annual Total*
Sales	$25.00	$2,100,000
Direct Materials	12.00	1,008,000
Direct Labor	6.00	504,000
Overhead	.50	42,000
Selling Expenses	1.75	147,000
Administrative Expenses	.25	21,000
Total Costs and Expenses	20.50	1,722,000
Operating Income	$ 4.50	$378,000

The Party Connection has received a special-order request for 15,000 packets at a price of $20 per packet to be shipped overseas. This transaction would not affect the company's current business. If 84,000 packets is 75% of capacity, 112,000 packets would be 100% of capacity. The Party Connection has the capacity to prepare the 15,000 packets requested without changing its existing operations. Should the Party Connection accept this special order? You can use the following information to decide. **[8]**

- Accepting this order would not impact current sales.
- To manufacture 15,000 packets would require $12.00 of direct materials and $6.00 of direct labor.
- The per unit overhead cost of $0.50 is 50% variable ($0.25) and 50% fixed ($0.25).
- Selling costs (includes commissions and delivery costs) for the 15,000 packets would be $7,000.
- Administrative expenses would not change.

Q.4a) Find a linear regression equation for the following two sets of data: **[5]**

x	2	4	6	8
y	3	7	5	10

b) The model for predicting the time to perform each unit of work is given by

$$T_n = K_t N^s$$

Tn = effort (time) required to complete the nth unit; N = unit number; K_t = constant; s = slope factor

Draw the best-fit line using linear regression method for the following data: **[10]**

N	10	30	100	150	300
T	510	210	190	125	71

(Hint: take log of the model equation).

Q.5 The following data is provided for a hydro-electric project (Project A) and a thermal project (Project B).

Project A is to be located in a land which will cost $80 million. Other Expenditure: Investigation and survey ($20 million); civil works ($1000 million); electrical works ($400 million); transmission and distribution network ($230 million); and establishment costs during construction ($320 million). It is expected that the project will require $55 million annually for maintenance purposes and an additional 0.5 per cent of capital costs will be spent annually on salaries and wages. It has a useful life of 30 years. 2000 million units of electricity is produced annually. Consumer is paying 20 cents per unit (1 dollar=100 cents). The liquidation yield of the project is $25 million.

Project B will require a one-off expenditure of $250 million to expand the coal mining capacity of the existing mine near the proposed site. The project site is currently priced at $65 million. Other infrastructure related costs for the project are estimated to be $1400 million. This project will have 15 years of useful life. The coal is priced at $40 per tonne. This coal, if no used for power generation, can be exported at a price of $60 per tonne. Salaries and wages to the employees will cost $30 million annually and maintenance an additional 1 per cent of the capital cost. In social terms, i.e. in terms of shadow prices, salaries and wages will amount to $10 million. Assume 2 million tonnes of coals are bought every year to generate electricity.

2000 million units of electricity is produced annually. Consumer is paying 20 cents per unit (1 dollar=100 cents). Also assume that 0.5 million tonne of coals are unused annually. The end-of-life value of the project is 0. The target rate of return of both the projects are 15% per annum.

(a) What is the net present value and internal rate of return of the project A? **[5+3]**

(b) What is the net present value and internal rate of return of the project B? **[5+3]**

(c) Evaluate the best project out of project A and B based on Net Present Value (NPV) and Internal Rate of Return (IRR). Comment on the significance of NPV and IRR. **[1+3]**