RESEARCH METHODOLOGY FOR ENGINEERING

1. A pot is fully filled (upto brims) with water. A cube of ice floating in it is partially submerged and partially seen above the water level. As the ice cube fully melts, what will happen to the level of water ?

(A) The water spills over

(B) The water level decreases

(C) The water level remains the same

(D) The water level increases

2. Suppose a 2-dimensional graph is to be plotted, with '*s*' as independent variable, '*p*' as dependent variable and also showing the impact of a 3rd variable, '*q*', on the '*p*' variable, then :

(A) independent variable, '*s*', is plotted along the *x*-axis; dependent variable, '*p*', is plotted along *y*-axis holding '*q*' constant, then other plots of '*s*' *vs.* '*p*' are done, each for a different value of '*q*' held constant.

(B) '*p*' is plotted along *x*-axis; '*s*' is plotted along *y*-axis holding '*q*' constant, then other plots of '*s*' *vs.* '*p*' are done, each for a different value of '*q*' held constant.

(C) '*s*' is plotted along *x*-axis; '*q*' is plotted along *y*-axis holding '*p*' constant, then other plots of '*q*' *vs.* '*s*' are done, each for a different value of '*p*' held constant.

(D) '*p*' is plotted along the *x*-axis; '*q*' is plotted along the *y*-axis holding '*s*' constant, then other plots of '*q*' *vs.* '*p*' are done, each for a different value of '*s*' held constant.

3. In a laboratory experiment, while plotting a graph,

(A) generally, 10 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.

(B) generally, 25 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.

(C) generally, 6 to 8 readings are taken, and a graph is plotted by connecting all the points plotted, even if it results in a zig-zag line.

(D) generally, 6 to 8 readings are taken, and a graph is plotted by drawing a smooth curve passing close to all points but may not touch all/several points.

4. The distinction between parameter and variable is :

(A) Parameter is an intrinsic property of the system and exists even if no input is applied to a system, while variable shows up only in response to applied input(s).

(B) Parameter is a fixed property of the system and exists even if no input is applied to a system, while variable is a variable quantity that shows up only in response to applied input(s).

(C) Parameter is a variable property of the system, while variable is a fixed property of the system.

(D) Parameter is a fixed property of the system and exists only if input is applied to a system, while variable is a variable property that shows up even if no input(s) is (are) applied.

5. In a class, the ratio of number of boys to girls is 5 : 3. What percentage of the students in the class are girls ?

(A) 37.5 %

(B) 50 %

(C) 60 %

(D) 62.5 %

6. If 25% of 260 equals 6.5% of P, what is P ?

(A) 65 (B) 100

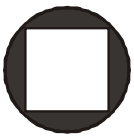
(C) 130 (D) 1000

7. How many different arrangements are there of the letters A, B, C and D ?

(A) 6 (B) 12

(C) 24 (D) 18

8. In the figure below, a square of perimeter 24 is inscribed in a circle. What is the area of shaded region ?



(A) $18\pi - 24$ (B) $18\pi - 36$

(C) $12\pi - 36$ (D) $9\pi - 36$

9. MULTAN : OUOTEN :: PURIFY: _____

(A) RUUIJY (B) OQTVQS

(C) QVSJEZ (D) None of these

10. If word PLAYER is coded as AELPRY, then word MANAGER is coded as :

(A) AEAGMNR (B) AAGEMNR

(C) AAEGMNR (D) AAEGNMR

11. In the sequence below, some letters are missing. From the choices, select the choice that gives the letters that can fill the blanks in the sequence :

a _ b _ _ _ a a _ b c _.

(A) abcabc (B) abccba

(C) abccbc (D) ababcc

12. The entropy of the universe is :

(A) decreasing

(B) increasing

(C) constant

(D) getting halved every year

13. How many 9's are there in the following sequence which are either immediately followed by 9 or immediately preceded by 9 :

793992896793579975

(A) Four (B) Two

(C) Three (D) One

14. What is the next letter in the series ?

B, D, G, K, P, __

(A) S (B) V

(C) W (D) X

15. True value of a quantity can be practically obtained by :

(A) mean of squares of a number of readings taken under no bias conditions such that positive deviations cancel out negative deviations.

(B) mean of a large number of readings taken under no bias conditions such that positive deviations cancel out negative deviations.

(C) whatever is measured by a laboratory or industrial meter.

(D) the actual value obtained after removing parallax error.

16. The sum, s, of probabilities of all outcomes of an event or a statistical experiment is :

(A) zero (B) $0 < s < 1$

(C) $0 \leq s \leq 1$ (D) 1

17. If '+' stands for '–', '–' stands for '×', '×' stands for '÷', and '÷' stands for '+', then evaluate :

$56 \times 7 \div 13 - 11 + 15 - 8 \div 2 - 7$

(A) 30 (B) 45

(C) 60 (D) 90

18. An engineer starts from home and travels 10 m towards West, then turns right and travels 40 m. He then travels 25 m East followed by 50 m towards the South to reach his factory. What is the approximate distance between his home and factory ?

(A) 18 m (B) 125 m

(C) 25 m (D) 105 m

19. A compass was damaged and its needle twisted / turned in such a manner that the pointer which was showing East, now showed North. A man went towards West as per the above mentioned compass. In which direction did he actually go ?

(A) South-West (B) South

(C) North-East (D) North

20. One evening, a person was facing a pole. The shadow of the pole fell to his right. Which direction he was facing ?

(A) East (B) West

(C) North (D) South

21. When a watch shows 3 : 45, the minute hand points towards East. When the watch shows 6 O'clock, in what direction will the hour hand point ?

(A) North (B) South

(C) East (D) West

22. A is the husband of B. E is the daughter of C. A is the father of C. How is B related to E ?

(A) Mother (B) Grandmother

(C) Aunt (D) Cousin

23. If we take the union and intersection respectively of a crisp/classical set with its compliment, what is the resultant in each case ?

(A) 1 and 0 respectively.

(B) 0 and 1 respectively.

(C) Universal set, X, and Null set, ø, respectively.

(D) Null set, ø, and Universal set, X, respectively.

24. If P, Q and R are matrices, and if PQ = PR, then it :

(A) does not imply that Q = R, except if P is non-singular.

(B) always implies that Q = R.

(C) never implies that Q = R.

(D) implies that Q and R are commutative under multiplication.

25. If P and Q are matrices, then :

(A) order of PQ is always the same as that of QP

(B) PQ = QP provided that matrices are conformable for multiplication in both cases

(C) in general, PQ may or may not be equal to QP

(D) both "A" and "B"

26. How many negative integers satisfy $|x+4|+|x-7|<13$?

(A) 2 (B) 3

(C) 4 (D) 5

27. If $x \in R$, the greatest value that $x^4 / (1 + x^8)$ attains is :

(A) 2/5 (B) 1/3

(C) 3/4 (D) 1/2

28. Researcher S's teaching experience (in years) is twice that of researcher M. But 2 years back, S's teaching experience was thrice that of M. How many years S has been teaching ?

(A) 8 years (B) 10 years

(C) 12 years (D) 16 years

29. If you add three quarters of the number of Labs I have, to three quarters of a Lab., you will get the number of Labs I have. How many labs do I have ?

(A) 3 (B) 4

(C) 6 (D) 9

30. A Ph.D. entrance test had 60 questions. A student scores 1 mark for a correct answer, –1/2 for a wrong answer and –1/4 for not attempting a question. A candidate attempted 48 questions and got a net score of 33 marks. How many questions did he attempt wrongly ?

(A) 8 (B) 12

(C) 14 (D) 10

31. Among the visitors to a Lab., the ratio of the number of Professors to B.Tech. students was the same as that of B.Tech. students to Research Scholars. Greater number of visitors were Research Scholars who were attracted by research facilities in the Lab. One day, 7 B.Tech. students visited the said Lab. How many Research Scholars visited the Lab. that day ?

(A) 44 (B) 49

(C) 52 (D) 57

32. A dealer bought an equipment at 30% discount on the list price. He then sold it at a price which is 160% of the list price, thereby making a profit of Rs. 81. What is the list price of the equipment ?

(A) 100 (B) 90

(C) 80 (D) 240

33. A researcher found that for the 1007 pages of his thesis, there were on an average 2 mistakes per page, while in the first 612 pages, there were only 434 mistakes, they seemed to increase for the latter pages. Find the average number of mistakes per page for the remaining pages :

(A) 6 (B) 4

(C) 2 (D) 3

34. After enjoying a feast at my college canteen with 12 friends, I paid Rs. 145 but my each friend paid an equal amount, say X. Later we found that the average sum paid by all of us was Rs. 5 more than what was originally paid by each of my friends. What amount did each friend pay ?

(A) Rs. 120 (B) Rs. 100

(C) Rs. 95 (D) Rs. 80

35. A tank of 60000 litres capacity has three inlet taps P, Q and R which can individually fill the tank in 20, 15 and 12 hours respectively. It has an outlet pipe S which can supply water to 100 houses. If all the pipes are opened simultaneously, how much water enters the tank every hour ?

(A) 8000 litres (B) 9600 litres

(C) 11400 litres (D) 12000 litres

36. In domestic installations, we get phase to ……. voltage which is about …… V while in industrial installations, we usually get phase to …… voltage which is about ……. V:

(A) neutral, 440, phase, 230 (B) neutral, 230, phase, 440

(C) neutral, 230, phase, 400 (D) phase, 230, neutral, 400

37. P, Q, R and S are motor wiremen. Working alone, wireman P can wire 1 motor in 12 hours. Q is 20% faster P. R is 50% faster than P. S is twice as fast as P. In how much time R alone can do wiring of 90 motors ?

(A) 720 hours (B) 600 hours

(C) 320 hours (D) 480 hours

38. P and Q run a closed circuit race. Besides leading just after start, P overtakes Q twice per round. What is P's speed compared to Q's ?

(A) 4 times (B) 3 times

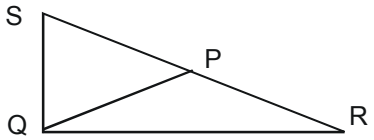
(C) 2 times (D) 5 times

39. An upstream journey of 18 km takes a motor boat 3 hours more than the same distance downstream. If the motor boat speed in still water is twice the speed of the stream, find the speed of the stream :

(A) 7.2 km/hr (B) 6 km/hr

(C) 4.5 km/hr (D) 4 km/hr

40. In the figure below, PQ = PR = PS and angle QRP = 30°. Find angle QSP.



(A) 30° (B) 40°

(C) 45° (D) 60°

41. In the table below, Types of Research are given on left hand side. A few Characteristics are given on the right hand side. Then in the further underneath Table, possible matches are given; select the best choice :

Research Types	**Characteristics**
(a) Fundamental research	(i) Finding out the extent of perceived impact of an intervention.
(b) Applied research	(ii) Developing an effective foundation through theory building.
(c) Action research	(iii) Improving an existing situation through the use of apt interventions.
(d) Evaluative research	(iv) Exploring the possibility of a theory for use in various situations.

	(a)	(b)	(c)	(d)
(A)	(i)	(ii)	(iii)	(iv)
(B)	(ii)	(iii)	(iv)	(i)
(C)	(iii)	(iv)	(i)	(ii)
(D)	(ii)	(iv)	(iii)	(i)

42. A researcher is asked, "What is the probability of finding an apple in the refrigerator ?" The researcher had no idea, neither knowledge nor prior information about an apple having been kept in the refrigerator. Yet he answers, without bias or inclination, as follows; what is his best answer ?

(A) 1.0 (B) 0.75

(C) 0.5 (D) 0

43. While writing a research paper, which one of the following statements is most *true* ?

(A) The 'Abstract' contains a gist of the entire paper but has no citation of references.

(B) The 'Abstract' contains a gist of the entire paper and has citation of references cited in the 'Abstract' part alone.

(C) The 'Future Directions' section must cite the possible offshoots which the authors perceive themselves as well as those perceived by previous researchers.

(D) The 'Materials and Methods' section, if detailed in the paper, must carry out a comprehensive analysis of results.

44. A chain has five links in it, each of which can individually carry a maximum weight of 2.3 Kg, 1.7 Kg, 5.3 Kg, 2.7 Kg and 0.7 Kg. Then which statement is most apt for this chain ?

(A) The strength of this chain is that of the strongest link in it

(B) The strength of this chain is that of the weakest link in it

(C) The strength of this chain is 12.7 Kg

(D) The strength of this chain is the average of the individual link strengths

45. What type of reasoning is used in the following statement ?

"Superiority of intellect depends on its power of concentration on one theme in the same way as a convex lens collects all the rays that strike upon it, into one point" :

(A) Psychological (B) Mathematical

(C) Deductive (D) Analogical

46. In the context of publications, which statement is *true* for SCI ?

(A) Scientific Citation Index is a citation index originally produced by the Institute for Scientific Information and created by Eugene Garfield.

(B) Super Citation Index is a citation index originally produced by the Institute for Scientist's Information and created by Bill Gates.

(C) Science Citation Index is a citation index originally produced by the Institute for Scientific Information and created by Eugene Garfield.

(D) Science Common Index is a citation index originally produced by the Institute for Scientific Information and created by Clarivate Analytics.

47. The term ICT usually refers to :

(A) An acronym that stands for Indian Classical Technologies

(B) Convergence of audio-visual and telephone networks with computer networks through a single cabling or link system

(C) Unified communications and integration of telecommunications, computers, enterprise software, middleware, audio-visual systems and storage

(D) Both "B" and "C"

48. With reference to a fixed frame of reference, your competitor moves forward with a velocity of 9.8 m/second while you too move forward a velocity of 5.2 m/sec with reference to the same frame. What is your velocity vis-à-vis that of your competitor ?

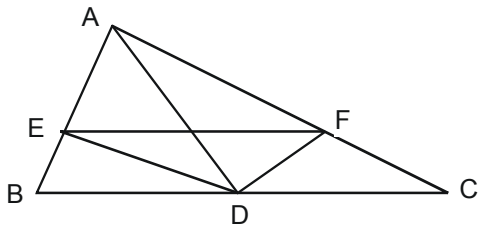
(A) 15 m/sec in forward direction

(B) 4.6 m/sec in forward direction

(C) 7.5 m/sec in forward direction

(D) 4.6 m/sec in backward direction

49. In the following figure (not drawn to scale), angle DEF = 35°. Find the other two angles of triangle DEF if DE and DF are the angle bisectors of angles ADB and ADC respectively :



(A) 30° and 120°

(B) 65° and 80°

(C) 55° and 90°

(D) 70° and 75°

50. A publisher publishes journals in two modes – Subscription mode, and Open access mode. Which choice is most correct in the context of an open access journal :

(A) It is a journal of which the subscription cost is borne by the subscriber.

(B) It is a journal of which the contents are freely accessible by anybody in the world.

(C) It is a journal of which the subscription cost per paper is borne by the respective author.

(D) "B" and "C"

51. A circular plate 1 m in diameter is submerged vertically in water such that its upper edge is 8 m below the free surface of water. The total hydrostatic force on one side of plate is :

(A) 6.7 kN (B) 65.4 kN

(C) 45 kN (D) 77 kN

52. The 2–D flow with velocity $V=(x+2y+2)i+(4-y)j$ is :

(A) Compressible and irrotational

(B) Compressible and rotational

(C) Incompressible and irrotational

(D) Incompressible and rotational

53. The velocity profile in fully developed laminar flow in a pipe of diameter D is given by $u=u_0\left(1-\frac{4r^2}{D^2}\right)$, where r is the radial distance from the centre. If the viscosity of the fluid is μ, the pressure drop across the length L of the pipe is :

(A) $\frac{\mu L u_0}{D^2}$ (B) $\frac{4\mu L u_0}{D^2}$

(C) $\frac{8\mu L u_0}{D^2}$ (D) $\frac{16\mu L u_0}{D^2}$

54. Consider an incompressible laminar boundary layer flow over a flat plate of length L, aligned with the direction of an incoming uniform free stream. If F is the ratio of the drag force on the front half of the plate to the drag force on the rear half, then :

(A) F > 1 (B) F = 1

(C) F = 0.5 (D) F < 0.5

55. Match the following :

List – I	List – II
P : Compressible flow	U : Reynolds number
Q : Free surface flow	V : Nusselt number
R : Boundary layer flow	W: Weber number
S : Pipe flow	X : Froude number
T : Heat Convection	Y : Mach number
	Z : Skin friction coefficient

(A) P-U, Q-X, R-V, S-Z, T-W

(B) P-Y, Q-W, R-Z, S-U, T-V

(C) P-W, Q-X, R-Z, S-U, T-V

(D) P-Y, Q-W, R-Z, S-V, T-X

56. A 0.5 mm thick plane wall has its two surfaces kept at 300ºC and 200ºC. Thermal conductivity of the wall varies linearly with temperature from 25 W/m-K to 15 W/m-K. The steady heat flux through the wall is :

(A) 8 kW/m^2 (B) 5 kW/m^2

(C) 4 kW/m^2 (D) 3 kW/m^2

57. Consider the following statements pertaining to large heat transfer rate using fins

I. Fins should be used on the side where heat transfer coefficient is small.

II. Large and thick fins should be used.

III. Short and thin fins should be used.

IV. Thermal conductivity of the fin material should be large.

Which of the above statements are *correct* ?

(A) I, II & IV (B) I, III & IV

(C) II, III & IV (D) I, II & III

58. Stefan-Boltzmann's law is applicable to :

(A) Black body (B) Grey body

(C) White body (D) All of the above

59. A cross flow type air-heater has an area of 50 m^2. The overall heat transfer coefficient is 100 W/m^2-K. The heat capacities of hot and cold streams are 800 W/K and 1000W/K, respectively. The value of NTU is (approximate) :

(A) 10 (B) 5

(C) 167 (D) 17

60. A frictionless piston cylinder device contains a gas initially at 0.8 MPa and 0.015 m^3. It expands quasi-statically at constant temperature to a final volume of 0.030 m^3. The work output (in kJ) during the process will be :

(A) 8.32 (B) 12

(C) 554.67 (D) None of the above

61. In the vicinity of triple point, the vapour pressure of liquid and solid ammonia are respectively given by $\ln p = 15.16 - 3063/T$, and $\ln p = 18.70 - 3754/T$, where p is in atmospheres and T is in kelvin. What is the temperature at critical point ?

(A) 691 (B) 283.49

(C) 195.2 (D) None of the above

62. The slope of constant volume and constant pressure lines in the T – S diagram are ..... and ..... respectively.

(A) Lower, higher (B) Higher, lower

(C) Same slope (D) Cannot predict

63. Low specific speed of hydraulic turbine implies it is :

(A) Pelton turbine (B) Bulb turbine

(C) Francis turbine (D) Kaplan turbine

64. Approach of cooling tower means :

(A) Difference in temperature of hot water entering and cold water leaving

(B) Difference in temperature of cold water leaving and WBT of surrounding air

(C) Difference in temperature of cold water entering and Atmospheric temperature

(D) Amount of heat thrown away by the cooling tower in kJ/h

65. Morse test is used to determine mechanical efficiency of :

(A) Single cylinder CI Engine (B) Single cylinder SI Engine

(C) Two-stroke engines (D) Multi-cylinder engines

66. Gas turbine works on :

(A) Brayton or Atkinson cycle

(B) Ericsson cycle

(C) Rankine cycle

(D) None of the above

67. Six jobs arrived in a sequence as given below :

Job	:	I	II	III	IV	V	VI
Completion Time (Days)	:	4	9	5	10	6	8

Average flow time (in days) for the above jobs using shortest processing time rule is :

(A) 139 (B) 125

(C) 20.83 (D) 23.16

68. Which one of the following forecasting techniques is *not* suited for making forecasts for planning production schedules in the short range ?

(A) Moving average
(B) Exponential moving average
(C) Regression analysis
(D) Delphi

69. One of the following statements about PRS (Periodic Reordering System) is *not* true :

(A) PRS provides basis for adjustments to account for variations in demand.
(B) PRS is useful in control of perishable items.
(C) PRS requires continuous monitoring of inventory levels.
(D) In PRS, inventory holding costs are higher than in Fixed Reorder Quantity System.

70. In computing Wilson's economic lot size for an item, by mistake the demand rate estimate used was 40% higher than the true demand rate. Due to this error in the lot size computation, the total cost of setup plus inventory holding per unit time would rise above the true optimum by approximately :

(A) 1.4 %
(B) 6.3 %
(C) 18.3 %
(D) 8.7 %

71. The supply of three sources is 50, 40 and 60 units, respectively while the demand at the four destinations is 20, 30, 10 and 50 units. In solving this transportation problem :

(A) A dummy source of capacity 40 units is needed.
(B) A dummy destination of capacity 40 units is needed.
(C) No solution exists as the problem is infeasible.
(D) No solution exists as the problem is degenerate.

72. Match the following :

Group I	**Group II**
P : G08	1. Linear interpolation
Q : G41	2. Acceleration
R : G01	3. Circular interpolation
S : G02	4. Cutter radius compensation

Options :

(A) P-3, Q-1, R-4, S-2

(B) P-4, Q-1, R-3, S-2

(C) P-3, Q-4, R-1, S-2

(D) P-2, Q-4, R-1, S-3

73. In a CAD package, a point P (6, 3, 1) is projected along a vector V (–2, 1, –1). The projection of this point on X-Y plane will be :

(A) (4, 4, 0) (B) (8, 2, 0)

(C) (7, 4, 0) (D) (2, 5, 0)

74. Consider a linear programming problem with two variables and two constraints. The objective function is : Maximize $X_1 + X_2$. The corner points of the feasible region are (0, 0), (0, 2), (2, 0) and (4/3, 4/3). If an additional constraint $X_1 + X_2 \leq 5$ is added, the optimum solution is :

(A) (5/3, 5/3) (B) (4/3, 4/3)

(C) (5/2, 5/2) (D) (5, 0)

75. A project has six activities (A to F) with respective activity durations 7, 5, 6, 6, 8, 4 days. The network has three paths A-B, C-D and E-F. All the activities can be crashed with the same crash cost per day. The number of activity(ies) that need to be crashed to reduce the project duration by one day is :

(A) 1 (B) 2

(C) 3 (D) 6

76. According to Chvorinove's rule, the solidification time of a casting is proportionate to (Volume/Surface area) n, where n equals to :

(A) 0.5 (B) 1

(C) 2 (D) 4

77. Match the following :

Work Material	**Type of joining**
P : Aluminium	1. Submerged Arc Welding
Q : Die Steel	2. Soldering
R : Copper Wire	3. Thermit Welding
S : Titanium Sheet	4. Atomic Hydrogen Welding
	5. Gas Tungsten Arc Welding
	6. Laser Beam Welding

Options :

(A) P-2, Q-5, R-1, S-3 (B) P-6, Q-3, R-4, S-5

(C) P-4, Q-1, R-6, S-2 (D) P-5, Q-4, R-2, S-6

78. Teeth of internal spur gears can be accurately cut in a :

(A) Milling Machine

(B) Gear shaping with pinion cutter

(C) Gear broaching

(D) Hobbing Machine

79. 3-2-1 method of location in jig or fixture would collectively restrict the work piece in '*n*' degree of freedom, where the value of '*n*' is :

(A) 6 (B) 8

(C) 9 (D) 12

80. The function of the draw bead in the deep drawing operations is to :

(A) Produce a balance between the amount of stretching and drawing.

(B) Produce a circular groove on the flange.

(C) Reduce the drawing load.

(D) Reduce the wrinkles on the flange.

81. A shaft has a dimension, $\phi 35^{-0.009}_{-0.025}$. The respective values of fundamental deviation and tolerance are :

(A) –0.025, ±0.008 (B) –0.025, 0.016

(C) –0.009, ±0.008 (D) –0.009, ±0.016

82. The surface finish of the component produced by a grinding process was measured. Based on the roughness parameters obtained, which one of the following is *true* ?

(A) $R_a < R_s < R_z < R_t$

(B) $R_s < R_a < R_z < R_t$

(C) $R_z < R_a < R_s < R_t$

(D) $R_a < R_z < R_s < R_t$

83. Gamma iron exists at temperature :

(A) Between 910ºC to 1400ºC

(B) Between 1400ºC to 1539ºC

(C) Between 779ºC to 910ºC

(D) Between 700ºC to 779ºC

84. Machining properties of steel are improved by adding :

(A) Sulphur, Lead, Phosphorous

(B) Silicon, Aluminium, Titanium

(C) Vanadium, Chromium, Nickel

(D) None of the above

85. A box contains 20 defective items and 80 non-defective items. If two items are selected at random without replacement, what will be the probability that both items are defective ?

(A) 1/25 (B) 19/495

(C) 1/5 (D) 20/99

86. Match the items in column I and II :

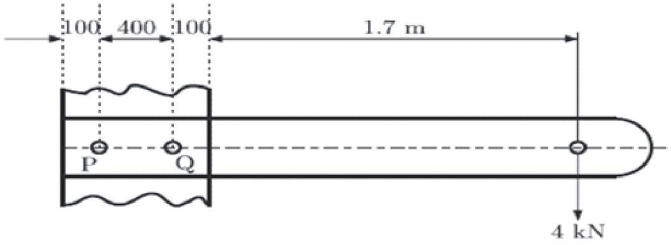
Column I	**Column II**
P. Gauss-Seidel method	1. Interpolation
Q. Forward Newton-Gauss method	2. Non-linear differential equations
R. Runge-Kutta method	3. Numerical integration
S. Trapezoidal Rule	4. Linear algebraic equations

Options :

(A) P-1, Q-4, R-3, S-2 (B) P-4, Q-1, R-2, S-3

(C) P-1, Q-3, R-2, S-4 (D) P-1, Q-4, R-2, S-3

87. A steel bar of 10 mm × 50 mm is cantilevered with two M 12 bolts (P and Q) to support a static load of 4 kN as shown in the figure. (Read 100 mm, 400 mm, 100 mm in Fig.) :



The primary and secondary shear loads on bolt P, respectively, are :

(A) 2 kN, 20 kN

(B) 20 kN, 2 kN

(C) 20 kN, 0 kN

(D) 0 kN, 20 kN

88. Two mating spur gears have 40 and 120 teeth respectively. The pinion rotates at 1200 rpm and transmits a torque of 20 Nm. The torque transmitted by the gear is :

(A) 6.6 Nm

(B) 20 Nm

(C) 40 Nm

(D) 60 Nm

89. Bars AB and BC, each of negligible mass, support load P as shown in the figure. In this arrangement :

(A) Bar AB is subjected to bending but bar BC is not subjected to bending.

(B) Bar AB is not subjected to bending but bar BC is subjected to bending.

(C) Neither bar AB nor bar BC is subjected to bending.

(D) Both bars AB and BC are subjected to bending

90. A gear set has a pinion with 20 teeth and a gear with 40 teeth. The pinion runs at 30 rev/s and transmits a power of 20 kW. The teeth are on the 20º full depth system and have a module of 5 mm. The length of the line of action is 19 mm. The contact ratio of the contacting tooth is :

(A) 1.21 (B) 1.25

(C) 1.29 (D) 1.33

91. A cylindrical shaft is subjected to an alternating stress of 100 MPa. Fatigue strength to sustain 1000 cycles is 490 MPa. If the corrected endurance strength is 70 MPa, estimated shaft life will be _____ cycles.

(A) 928643 (B) 281914

(C) 15000 (D) 1071

92. A shaft subjected to torsion experiences a pure shear stress τ on the surface. The maximum principal stress on the surface is at 45º to the axis will have a value :

(A) $\tau \cos 45^\circ$

(B) $2\tau \sin 45^\circ \cos 45^\circ$

(C) $2\tau \cos 45^\circ$

(D) $\tau \cos^2 45^\circ$

93. The transverse shear stress acting in a beam of rectangular cross-section, subjected to a transverse shear load, is :

(A) variable with maximum at the bottom of the beam

(B) variable with maximum at the top of the beam

(C) uniform

(D) variable with maximum on the neutral axis

94. According to Von-Mises' distortion energy theory, the distortion energy under three-dimensional stress state is represented by :

(A) $\frac{1}{2E}\left[\sigma_1^2+\sigma_2^2+\sigma_3^2-2\nu\left(\sigma_1\sigma_2+\sigma_3\sigma_2+\sigma_1\sigma_3\right)\right]$

(B) $\frac{1-2\nu}{6E}\left[\sigma_1^2+\sigma_2^2+\sigma_3^2+2\nu\left(\sigma_1\sigma_2+\sigma_3\sigma_2+\sigma_1\sigma_3\right)\right]$

(C) $\frac{1+\nu}{3E}\left[\sigma_1^2+\sigma_2^2+\sigma_3^2-\left(\sigma_1\sigma_2+\sigma_3\sigma_2+\sigma_1\sigma_3\right)\right]$

(D) $\frac{1}{3E}\left[\sigma_1^2+\sigma_2^2+\sigma_3^2-\nu\left(\sigma_1\sigma_2+\sigma_3\sigma_2+\sigma_1\sigma_3\right)\right]$

95. The ratio of Euler's bucking loads of columns with the same parameters having (i) both ends fixed, and (ii) both ends hinged is :

(A) 4 (B) 2

(C) 8 (D) 6

96. The following are the data for two crossed helical gears used for speed reduction :

Gear I : Pitch circle diameter in the plane of rotation 80 mm and helix angle 30º.

Gear II : Pitch circle diameter in the plane of rotation 120 mm and helix angle 22.5º.

If the input speed is 1440 rpm, the output speed in rpm is :

(A) 1200 (B) 900

(C) 875 (D) 720

97. If C_f is the coefficient of speed fluctuation of a flywheel, then the ratio of $\omega_{max}/\omega_{min}$ will be :

(A) $\frac{1-2C_f}{1+2C_f}$

(B) $\frac{2-C_f}{2+C_f}$

(C) $\frac{1+2C_f}{1-2C_f}$

(D) $\frac{2+C_f}{2-C_f}$

98. A vibrating machine is isolated from the floor using springs. If the ratio of excitation frequency of vibration of machine to the natural frequency of the isolation system is equal to 0.5, then transmissibility ratio of isolation is :

(A) 1/2

(B) 3/4

(C) 4/3

(D) 2

99. The Coriolis component of acceleration is present in :

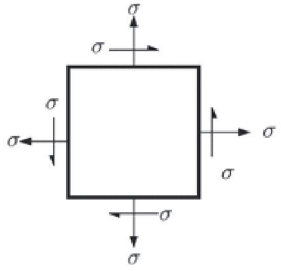
(A) Shape mechanism

(B) 4 bar mechanisms with 4 turning pairs

(C) Slider-crank mechanism

(D) Scotch yoke mechanism

100. The maximum principal stress for the stress state shown in the figure is :



(A) σ

(B) 2σ

(C) 3σ

(D) 1.5σ