1. Thermal diffusivity of material 'A' is $100 \text{ m}^2/\text{s}$ and material 'B' is $200 \text{ m}^2/\text{s}$, then heat absorb by

   (a) A is more than B

   (b) B is more than A

   (c) Both are same

   (d) Can not be predicted

2. At room temperature, the ratio of radiation heat transfer coefficient and the surface emissivity is about

   (a) 1.5   (b) 2.0

   (c) 3.0   (d) 6.0

3. Thermal conductivity of gases with increase in molecular weight

   (a) increases   (b) decreases

   (c) remain same   (d) none of these

4. A furnace wall has x = 10 cm and k = 0.2 W/mK with surface temperature of 500°C and 300°C. The rate of heat transfer by conduction is

   (a) 100 W/m^2 (b) 200 W/m^2

   (c) 300 W/m^2 (d) 400 W/m^2

5. The heat flow line at a point in a solid is along a path parallel to the

   (a) Isotropic surface

   (b) Isothermal surface

   (c) Adiabatic surface

   (d) Isobaric surface

6. In a fully developed laminar flow through a tube

   (a) $\dfrac{\partial u}{\partial x} = 0$

   (b) $\dfrac{\partial T}{\partial x}$ at any radius (r) is not zero

   (c) The temperature profile continuously changes with 'x'

   (d) All of the above

7. Which of these is/are properties of fluid

   (1) Eddy viscosity

   (2) Eddy diffusivity

   (3) Kinematic viscosity

   (a) (1) and (3)   (b) (2) and (3)

   (c) (3) only   (d) (1), (2) and (3)

8. The convective heat transfer coefficient for laminar and turbulent flows over a flat plate varies respectively as

   (a) $x^{1/2}$ and $x^{0.2}$ (b) $x^{1/2}$ and $x^{-0.2}$

   (c) $x^{-1/2}$ and $x^{-0.2}$ (d) $x^{-1/2}$ and $x^{0.2}$

9. In liquid metal heat transfer, Nusselt number is a function of which dimensionless number

   (a) Pr only

   (b) Re only

   (c) Peclet only

   (d) Peclet and Re

10. In nucleate boiling to form the nuclii of bubble there must be present

    (a) superheated vapour

    (b) dissolved gases

    (c) undissolved gases

    (d) superheated liquid

11. In nucleate boiling, bubbles always originate

    (a) in the bulk of the liquid

    (b) on the heating surface

    (c) where the liquid superheat is minimum

    (d) where the liquid is saturated

12. From these two statements:

    (1) In forced convection boiling inside a tube, the heat transfer coefficient increases sharply in the bubble flow regime.

    (2) Because the bubbles appearing at the surface grow and are carried away into the liquid

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stream.

(a) (1) is true, (2) is false

(b) (1) is false, (2) is true

(c) Both are false

(d) Both are true

13. Cavities on the heating surface are used most advantageously when the entire surface is exposed to

(a) nucleate boiling   (b) film boiling

(c) transition boiling   (d) pool boiling

14. From these two statements:

(1) The rate of condensation on a rusty surface is more than that on a polished surface.

(2) The polished surface promotes dropwise condensation

(a) (1) is true, (2) is false

(b) (1) is false, (2) is true

(c) Both are false

(d) Both are true

15. For a balanced counter flow heat exchanger given that NTU is 1.5, then calculate its effectiveness

(a) 0.5   (b) 0.55

(c) 0.60   (d) 0.65

16. In a shell and tube heat exchanger, baffles are provided on the shell side to which is incorrect statement

(a) prevent the stagnation of the shell side fluid

(b) improve heat transfer

(c) provide support for tubes

(d) prevent fouling of tubes

17. For a counter flow shell and tube heat exchanger given that $\dot{m}_h C_h = 4000$ W/K and $\dot{m}_c C_c = 2000$ W/K, overall heat transfer coefficient is U = 500 W/m^2K. What should be the area of heat transfer? given NTU = 1.5

(a) 2 m^2 (b) 4 m^2

(c) 6 m^2 (d) 8 m^2

18. For a balanced parallel flow heat exchanger, the temperature profile of the two fluids along the length of the heat exchanger

(a) linear   (b) parallel

(c) linear and parallel (d) parabolic

19. At thermal equilibrium

(1) The net radiation heat exchange is zero

(2) Radiation mechanism stop

Of these two statements:

(a) (1) is true, (2) is false

(b) (1) is false, (2) is true

(c) Both are true

(d) Both are false

20. Thermal conductivity of water if temperature increases from 20°C to 100°C

(a) decreases

(b) increases

(c) first increases than decreases

(d) first decreases than increases

21. What is the correct decreasing order of thermal diffusivity (α)

(a) liquid > gases > metal

(b) gases > liquid > solid

(c) solid > gases > liquid

(d) gases > solid > liquid

22. From these two statement:

(1) In forced convection heat transfer does not depends on orientation.

(2) In natural convection heat transfer by density difference

(a) (1) is true, (2) is false

(b) (1) is false, (2) is true

(c) Both are false

(d) Both are true

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23. In thermal boundary layer assumptions taken are

   (1) Steady state

   (2) Incompressible

   (3) 2D flow

   (4) Assuming conduction in x-direction

   (5) Properties of fluid, evaluated at mean film temperature

   (a) (1), (2), (3), (5)   (b) (1), (2), (5)

   (c) (1), (3), (4)   (d) (1), (2), (3), (5)

24. The peizometric head of flow is

   (a) The sum of the velocity head and datum head

   (b) The sum of pressure head and datum head

   (c) The sum of pressure head and velocity head

   (d) The sum of velocity head, pressure head, and datum head

25. The Euler's number is written as

   (a) $\dfrac{V}{\sqrt{K/\rho}}$ (b) $\dfrac{\rho V^2 L}{\sigma}$

   (c) $\dfrac{\rho V}{\sqrt{\Delta P}}$ (d) $\dfrac{V}{\sqrt{\Delta P/\rho}}$

26. In a laminar flow through a circular pipe of diameter 20 cm. The maximum velocity is found to be 1 m/s. The velocity at radial distance of 5 cm from the axis of the pipe will be

   (a) 0.25 m/s   (b) 0.5 m/s

   (c) 0.75 m/s   (d) 0.1 m/s

27. In calculating the lift force

   (a) Always the frontal area is used

   (b) Always the plan form area is used

   (c) Plan form area is used if the body is a lifting surface

   (d) Actual surface area of the body is used

28. Prantdl's mixing length in a pipe flow is

   (a) A constant

   (b) Zero at the pipe wall

   (c) A function of shear stress at the wall

   (d) A function of Reynolds number

29. The stagnation pressure in front of an object in a fluid flow is equal to

   (a) Static pressure

   (b) Dynamic pressure

   (c) Sum of static and dynamic pressure

   (d) Piezometric head

30. A surge tank is provided in hydraulic power schemes to

   (a) Strengthen the penstokes

   (b) Reduce water hammer pressure

   (c) Reduce frictional losses in the system

   (d) Increase the net head

31. A turbine develops 2515 kW at 240 rpm. The torque in the shaft

   (a) 400 kN-m   (b) 3335 kN-m

   (c) 1000 kN-m   (d) 100 kN-m

32. An air vessels is used in reciprocating pump

   (a) to obtain continuous supply of fluid at uniform rate

   (b) to reduce suction head

   (c) to increase delivery head

   (d) to reduce cavitation

33. The viscosity of

   (a) Liquids increases with temperature

   (b) Gases increases with temperature

   (c) Fluids decreases with temperature

   (d) Fluids increases with temperature

34. Bourden gauge measures

   (a) Absolute pressure

   (b) Gauge pressure

   (c) Local atmospheric pressure

   (d) Standard atmospheric pressure

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35. A large metacentric height in a vessel

    (a) Improves stability and makes periodic time of oscillation longer

    (b) Improves stability and makes periodic time of osciallation shorter

    (c) Has no effect on stability or periodic time of oscillation

    (d) Improves stability and makes periodic time of oscillation shorter

36. Cauchy-Reimann equation relating 'ϕ' and 'ψ' are

    (a) $\dfrac{\partial\phi}{\partial x}=\dfrac{\partial\phi}{\partial y}$, $\dfrac{\partial\psi}{\partial x}=-\dfrac{\partial\psi}{\partial y}$

    (b) $\dfrac{\partial\phi}{\partial x}=-\dfrac{\partial\phi}{\partial y}$, $\dfrac{\partial\phi}{\partial y}=-\dfrac{\partial\psi}{\partial y}$

    (c) $\dfrac{\partial\phi}{\partial x}=\dfrac{\partial\psi}{\partial x}$, $\dfrac{\partial\phi}{\partial y}=-\dfrac{\partial\psi}{\partial y}$

    (d) $\dfrac{\partial\phi}{\partial x}=-\dfrac{\partial\psi}{\partial y}$, $\dfrac{\partial\phi}{\partial y}=\dfrac{\partial\psi}{\partial x}$

37. Kinetic energy correction factor 'α' is define as

    (a) $\dfrac{1}{A^3V^3}\int v^3.dA$

    (b) $\dfrac{1}{A}\int v^3.dA$

    (c) $\dfrac{1}{AV^3}\int vdA$

    (d) $\dfrac{1}{AV^3}\int v^3.dA$

38. In a circular pipe of certain length carrying oil at a Reynold's number 100, it is proposed to triple the discharge. If the viscosity remains unchanged, the power input will have to be

    (a) Decreased to 1/3rd its original value

    (b) Increased by 100 %

    (c) Increased to 3 times the original value

    (d) Increased to 9 times its original value

39. In the case of flow over a flat plate the growth of the boundary layer

    (a) Decreases with an increase in kinematic viscosity

    (b) Increases with an increase in the free stream velocity

    (c) Decrease with an increase in the free stream velocity only if the boundary layer is laminar

    (d) Increase with an increase in the kinematic viscosity in both laminar and turbulent boundary layer

40. The lift force on a body

    (a) is due to buoyant force

    (b) is always in the direction of the gravity

    (c) is the component of the resultant force in a vertical direction

    (d) is the component of the resultant force in a direction normal to relative velocity

41. Shear velocity is

    (a) A non- dimensional quantity

    (b) A convenient fictitious quantity

    (c) The velocity of fluid at the edge of laminar sub layer

    (d) The velocity of fluid at the edge of roughness.

42. What will happen if diesel is fed by mistake in the oil tank of a petrol engine?

    (a) The engine will not run

    (b) The engine will knock

    (c) The engine will detonate

    (d) The engine will give lot of smoke

43. Maximum torque is generated by an engine when

    (a) It develops maximum power

    (b) It runs at lowest speed

    (c) It consumes maximum fuel

    (d) It runs at maximum speed

44. What is the method of governing used in petrol engines?

    (a) Quality governing

    (b) Hit & trail governing

    (c) Quantity governing

    (d) Any of the above

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45. Regarding contact breaker which of the following statements is incorrect?

    (a) Spark takes place when the points are open

    (b) Excessive gas results in rapid burning of points

    (c) Contact points are generally made of tungsten

    (d) Points are opened by the cam & closed by the spring tension

46. Crankshafts are generally

    (a) Die cast   (b) Sand cast

    (c) Forged   (d) Turned from bar stock

47. Which of the following has maximum resistance to detonation

    (a) Alcohol   (b) Benzene

    (c) Toluene   (d) Iso-octane

48. The top ring nearest to the piston crown is known as

    (a) Compression ring (b) Oil ring

    (c) Scrapper ring   (d) Groove ring

49. In a C.I. engine squish is created

    (a) at the end of suction stroke

    (b) towards the end of compression stroke

    (c) at the beginning of suction stroke

    (d) during combustion

50. Why the exhaust pipes of engines covered with insulating material?

    (a) To conserve heat

    (b) To keep the exhaust pipes warm

    (c) To reduce heat transfer to the engine room

    (d) To increase the engine efficiency

51. Which type of cleaner in case of diesel engines is most effective?

    (a) Wet type   (b) Dry type

    (c) Oil bath type   (d) Whirl type

52. Ratio of actual indicated work to hypothetical indicated work in a steam engine is the

    (a) Indicated thermal efficiency

    (b) Friction factor

    (c) Mechanical efficiency

    (d) Diagram factor

53. A double acting steam engine with a cylinder diameter of 19 cm and a stroke of 30 cm has a cut-off of 0.35. The expansion ratio for this engine is nearly

    (a) 1.05   (b) 2.85

    (c) 6.65   (d) 10.05

54. Which one of the following fuel is used to determine the water equivalent of a bomb calorimeter?

    (a) Benzoic acid   (b) Octane

    (c) Coke   (d) Cetane

55. Hot coffee in a cup is allowed to cool. Its cooling rate is measured and found to be greater than the value calculated by conduction, convection and radiation measurements. The difference is due to

    (a) Properties of coffee changing with temperature

    (b) Currents of air flow in the room

    (c) Under estimation of the emissivity of a coffee

    (d) Evaporation

56. *Assertion (A) :* Reaction turbines are not built on pure reaction principle

    Reason (R) : Pure reaction is difficult to realise in practice

    (a) Both A and R are individually true and R is the correct explanation of A.

    (b) Both A and R are individually true but R is not the correct explanation of A.

    (c) A is true but R is false.

    (d) A is false but R is true.

57. The following data refer to an axial flow turbine stage : Relative velocity of steam at inlet to the rotor is 79 m/s, relative velocity at the rotor exit = 152 m/s, rotor mean peripheral velocity = 68.4 m/s, work output per kg of steam = 14100 J. What is the approximate degree of reaction?

    (a) 0.9   (b) 0.8

    (c) 0.7   (d) 0.6

58. *Assertion (A) :* The air-fuel ratio employed in a gas turbine is around 60 : 1.

    Reason (R) : A lean mixture of 60 : 1 in a gas turbine is mainly used for complete combustion.

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(a) Both A and R are individually true and R is the correct explanation of A.

(b) Both A and R are individually true but R is not the correct explanation of A.

(c) A is true but R is false.

(d) A is false but R is true.

59. Consider the following statements expansion joints in steam pipelines are installed to

1. Allow for future expansion of plant

2. Take stresses away from flanges and fittings

3. Permit expansion of pipes due to temperature rise

Of these correct statements are

(a) 1, 2 and 3   (b) 1 and 2

(c) 2 and 3   (d) 1 and 3

60. If 15 m^3/s air flow at 10 mm Hg head, which one of the following would be the best choice?

(a) Centrifugal fan with forward curved blades

(b) Axial fan with a large number of blades in rotor

(c) Axial propeller fan with a few blades in rotor

(d) Cross-flow fan

61. Dry flue gases with a composition of CO_2 = 10.4%, O_2 = 9.6 and N_2 = 80% indicate that

(a) Excess air is used

(b) Air is insufficient

(c) Hydrogen is not present in the coal

(d) Air is just sufficient

62. Consider the following statements :

The maximum temperature produced by the combustion of a unit mass of fuel depends upon

1. LCV

2. Ash content

3. Mass of air supplied

4. Pressure in the furnace

Of these statements

(a) 1 alone is correct

(b) 1 and 3 are correct

(c) 2 and 4 are correct

(d) 3 and 4 are correct

63. Which one of the following gaseous fuels does not have different higher and lower calorific values?

(a) Methane   (b) Ethane

(c) Carbon Monoxide (d) Hydrogen

64. Match List-I with List-II and select the correct answer using the codes given below the lists

	List-I		List-II
A.	Sulphur Candle Test	**1.**	Propane
B.	Halide Torch Test	**2.**	Ammonia
C.	Soap and Water Test	**3.**	Halo Carbon Refrigerants
D.	Ammonia Swab Test	**4.**	Sulphur Dioxide

Codes :	A	B	C	D
(a)	2	3	1	4
(b)	4	1	3	2
(c)	2	1	3	4
(d)	4	3	1	2

65. Which one of the following refrigerants has the highest critical temperature?

(a) Water   (b) Carbon Dioxide

(c) Freon   (d) Ammonia

66. The colour of the flame of halide torch, in case of a leakage of a freon refrigerant, will change to

(a) bright green   (b) yellow

(c) red   (d) orange

67. A refrigeration compressor designed to operate with R 22.......... (can/cannot) be operated with R-12 because the condensing pressure of R-22 at any given temperature is .... (higher/ lower) than that of R-12.

(a) Cannot; Higher   (b) Can; Higher

(c) Cannot; Lower   (d) Can; Lower

68. Match List-I (types of test and material) with List-II (types of fractures) and select the correct answer using the codes given below

List-I

(a) tensile test on CI

(b) torsion test on MS

(c) tensile test on MS

(d) torsion test on CI

List-II

1. Plain fracture on transverse plain

2. Granular helicoidal fracture

3. Plain granular at 45° to the axis

4. Cup and cone

5. Granular fracture on a transverse plane

Codes :

	A	B	C	D
(a)	4	2	3	1
(b)	5	1	4	2
(c)	4	1	3	2
(d)	5	2	4	1

69. Which one of the following properties cannot be evaluated by static tension test

(a) Shear strength

(b) Modulus of elasticity

(c) Ductility

(d) Poisson's ratio

70. A cube having each side of length 'a' is constrained in all directions and is heated uniformly so that the temperature is raised to T°C. If 'α' is the thermal coefficient of expansion of the cube material and 'E' is the modulus of elasticity the stress developed in the cube is

(a) $\dfrac{\alpha TE}{2\mu}$

(b) $\dfrac{\alpha TE}{(1-2\mu)}$

(c) $\dfrac{\alpha TE}{2\mu}$

(d) $\dfrac{\alpha TE}{(1+2\mu)}$

71. Match List-I with List-II and select the correct answer using codes given below

List-I

(a) Membrane Stress

(b) Torsional Shear Stress

(c) Double Shear Stress

(d) Maximum Shear Stress

List-II (Situation/Location)

1. Neutral axis of beam

2. Closed coil helical spring under axial load

3. Cylindrical shell subjected to fluid pressure

4. Rivets of double strap butt joint

Codes :

|	A	B	C	D
(a)	3	1	4	2
(b)	4	2	3	1
(c)	3	2	4	1
(d)	4	1	3	2

72. A circular shaft shown in the figure is subjected to torsion 'T' at two points 'A' and 'B'. The torsional rigidity of portions CA and BD is GJ_1 and that of portion 'AB' is GJ_2. The rotation of shaft at points 'A' and 'B' are θ_1 and θ_2. Then the rotation 'θ_1' is
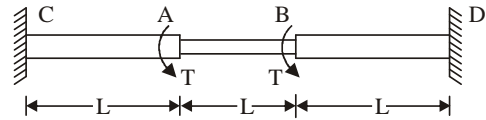
(a) $\dfrac{TL}{GJ_1 + GJ_2}$

(b) $\dfrac{TL}{GJ_1}$

(c) $\dfrac{TL}{GJ_2}$
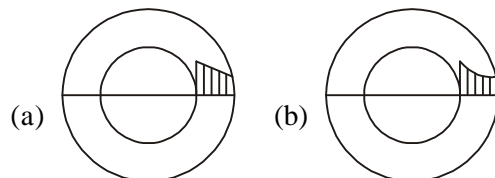
(d) $\dfrac{TL}{GJ_1 - GJ_2}$

73. A cantilever beam the cross-section of an isosceles triangle and is loaded as shown in fig. If the moment of inertia of the cross-section I_{zz}
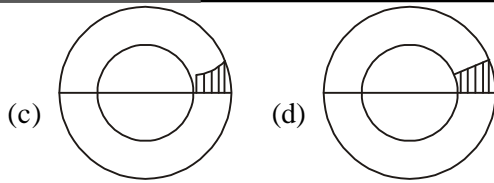
$=\dfrac{1}{36}\,m^4$ then the maximum tensile bending stress

Cross Section
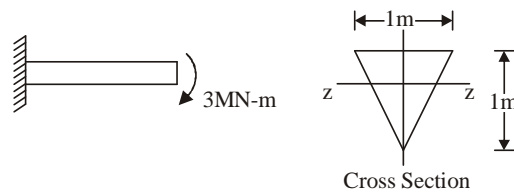
(a) $\dfrac{1}{16}$ MPa

(b) 72 MPa

(c) 36 MPa

(d) $\dfrac{1}{36}$ MPa

74. A thick cylindrical pressure vessel of inner diameter D_1 and outer diameter D_0 is subjected to an internal fluid pressure of intensity 'P' the variation of the circumferential tensile stress 'σ_y' in the thickness of the shell will be

(a)

(b)

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(c)   (d)

75. The bending moment diagram for a beam AB is shown in the below figure. What is the nature of the beam
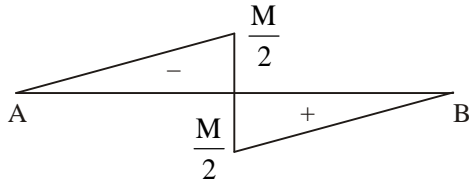
(a) simply supported with a concentrated load at its mid length

(b) simply supported and is subjected to a couple 'M' at its mid point

(c) simply supported and carries a uniformly varying load from zero at the supported to maximum at its mid length

(d) A cantilever subjected to end moment 'M'

76. In solidification of metal during casting compensation during solid contraction is

(a) Provided by the oversize pattern

(b) Achieved by properly placed risers

(c) Obtained by promoting directional solidification

(d) Made by providing chills

77. In which of the following are metal moulds used

(a) Green sand mould

(b) Dry sand mould

(c) Die casting process

(d) Loam moulding

78. Misrun is a casting defects which occurs due to

(a) Very high pouring temperature of the metal

(b) Insufficient fluidity of the molten metal

(c) Absorption of gases by the liquid metal

(d) Improper alignment of the mould flasks

79. According to Chovrinov's equation, the solidification time of a casting is proportional to

(a) V^2 (b) V

(c) $\dfrac{1}{V}$ (d) $\dfrac{1}{V^2}$

Where, V = Volume of casting.

80. In a machining operation chip thickness ratio is 0.3 and back rake angle of the tool is 10°. What is the value of shear strain

(a) 2.24   (b) 0.86

(c) 3.1   (d) 3.34

81. Power consumption in metal cutting is mainly due to

(a) Tangential component of the force

(b) Longitudinal component of the force

(c) Normal component of the force

(d) Friction of the metal tool interface

82. In orthogonal cutting, the feed is 0.5 mm at a cutting speed of 2 m/s. If the chip thickness is 0.75 mm, the chip velocity is (Consider the rake angle as zero)

(a) 1.33 m/sec   (b) 2 m/sec

(c) 2.5 m/sec   (d) 3 m/sec

83. The time taken to face a workpiece of 72 mm length. If the spindle speed is 80 rpm and cross-feed is 0.3 mm/rev is

(a) 1.5 minutes   (b) 3.0 minutes

(c) 5.4 minutes   (d) 8.5 minutes

84. The angle between the face and the flank of the single point cutting tool is known as

(a) Rake angle   (b) Clearance angle

(c) Lip angle   (d) Point angle

85. In a single point turning operation to steel with a cemented carbide tool, Tailor's tool life exponent is 0.25. If the cutting speed is halved, the tool life will increase by

(a) Two times   (b) Four times

(c) Eight times   (d) Sixteen times

86. In rolling process roll separating force can be decreased by

(a) Reducing roll diameter

(b) Increasing roll diameter

(c) Providing backup rolls

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(d) Increasing the friction between rolls and metal

87. In a transportation problem north-west corner, rule would yield

(a) An-optimum solution

(b) An-initial feasible solution

(c) A Vogel's's approximate solution

(d) A minimum cost solution

88. Match List-I (Techniques/Methods) With List-II(Models) and select the correct answer using the codes given below the lists:

List-I		List-II
A. Vogel's approximation method	1.	Assignment model
B. Floods technique	2.	Transportation model
C. Two phase method	3.	PERT and CPM
D. Crashing	4.	Linear programming

Code:	A	B	C	D
(a)	3	4	1	2
(b)	2	1	4	3
(c)	3	1	4	2
(d)	2	4	1	3

89. Which one of the following is not the solution method of transportation problems

(a) Hungarian method

(b) Northwest corner method

(c) Least cost method

(d) Vogel's approximation method

90. In an assignment problem having 'n' facilities and 'n' jobs, what is the number of possible ways of making assignments

(a) n   (b) n^2

(c) 2n   (d) 4n

91. Single server queue customers are served a rate of 'μ' if 'W' and W_q represent the mean waiting time in the system and mean waiting time in the queue respectively, then 'W' will be equal to

(a) $W_q - \mu$ (b) $W_q + \mu$

(c) $W_q + \dfrac{1}{\mu}$ (d) $W_q - \dfrac{1}{\mu}$

92. For a M/M/1: ∞/Fc/Fs queue, the mean arrival rate is equal to 10 per hour and the mean service rate is 15 per hour. The expected queue length is

(a) 1.33   (b) 1.53

(c) 2.715   (d) 3.20

93. If the arrivals are completely random, then what is the probability distribution of number of arrivals in a given time

(a) Negative exponential

(b) Binomial

(c) Normal

(d) Poisson

94. In a single server assuming system with arrival rate of 'λ' and mean services time of 'μ' the expected number of customers in the system is $\dfrac{\mu}{(\mu - \lambda)}$. What is the expected waiting time per customer in the systems?

(a) $\dfrac{\lambda^2}{\mu - \lambda}$ (b) $\mu - \lambda$

(c) $\dfrac{1}{\mu - \lambda}$ (d) $\dfrac{(\mu - \lambda)}{\lambda}$

95. The cost of providing service in a queue system increases with

(a) Increased mean time in the queue

(b) Increased arrival rate

(c) Decrease mean time in the queues

(d) Decrease arrival rate

96. EOQ is taken at the point where the cost of carrying equal the cost of

(a) Ordering the materials

(b) The material

(c) The safety stock

(d) Both the material and the safety stock

97. Read the following statement

(i) Wind speed decreases after passing through rotor and minimum in the rotor wake

(ii) There is a pressure drop occurs as the wind stream passes through the rotor

From these statements

(a) (i) is true, (ii) is false

(b) (i) is false, (ii) is true

(c) Both (i) and (ii) are false

(d) Both (i) and (ii) are true

98. **Assertion (A):** Stream lined objects experience much smaller drag forces than blunt objects.

Reason (R): Drag forces act in the direction of the air flow while lift forces act perpendicular to flow.

(a) Both A and R are true and R is the correct explanation of A

(b) Both A and R are true, but R is not the correct explanation of A

(c) A is true, but R is false

(d) R is true, but A is false

99. For efficient operation, the blades of a wind turbine need to function with

(a) Maximum possible lift and minimum possible drag

(b) Minimum possible lift and maximum possible drag

(c) Lift and drag both equal

(d) All above case give equal efficiency

100. What is the advantage of the vertical axis machine over horizontal axis machine in wind power plant?

(a) Gives higher power

(b) Gives continuous power

(c) High efficiency

(d) Can operate in all direction

101. Failure of a material is called fatigue when it fails

(a) at the elastic limit

(b) below the elastic limit

(c) at the yield point

(d) below the yield point

102. If the size of a standard specimen for a fatigue testing machine is increased, the endurance limit for the material will

(a) Increase

(b) Decrease

(c) Not change

(d) None of the above

103. Stress concentration factor is defined as the ratio of

(a) Maximum stress to the endurance limit

(b) Nominal stress to the endurance limit

(c) Maximum stress to the nominal stress

(d) Nominal stress to the maximum stress

104. The residual compressive stress by way of surface treatment of a machine member subjected to fatigue loading

(a) Improves the fatigue life

(b) Deteriorates the fatigue life

(c) Does not affect the fatigue life

(d) Immediately fracture the specimen

105. In static loading, stress concentration is more serious in

(a) Brittle materials

(b) Ductile materials

(c) Both (a) and (b)

(d) Elastic materials

106. Which of the following joint is commonly used for joining pipes carrying water at low pressure?

(a) Universal joint

(b) Spigot and socket joint

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(c) Socket or a coupler joint

(d) Nipple joint

107. A rivet is specified by

(a) Shank diameter   (b) Length of rivet

(c) Type of head   (d) Length of tail

108. A line joining the centres of rivets and parallel the edge of the plate is known as

(a) Marginal pitch   (b) Pitch line

(c) Back pitch   (d) Gauge line

109. The objective of caulking in a riveted joint is to make the joint

(a) Free from corrosion

(b) Stronger in tension

(c) Leak proof

(d) Free from stresses

110. In liquification process ?

(a) Conversion occurs at high temperature with controlled air

(b) Conversion occurs at high temperature and very less oxygen supply

(c) Conversion occurs at low temperature when rapidly heated

(d) None of above

111. When a perfect gas is expanded through an aperture of minute dimensions, the process is known as

(a) Isothermal process

(b) Adiabatic process

(c) Free expansion process

(d) Throttling process

112. When the gas is heated at constant pressure, the heat supplied

(a) Increases the internal energy of the gas

(b) Increases the temperature of the gas

(c) Does some external work during expansion

(d) Both (b) & (c)

113. Work done in a free expansion process is

(a) Positive   (b) Negative

(c) Zero   (d) Maximum

114. In a thermodynamic cycle consisting of four processes, the heat and work are as follows :

Q : +30, –10, –20, +5

W : +3, 10, –8, 0

The thermal efficiency of the cycle will be

(a) Zero   (b) 7.15 %

(c) 14.33 %   (d) 28.6 %

115. The heat transferred in a thermodynamic cycle of a system consisting of four processes is successively 0, 8, 6 and –4 units. The net change in the internal energy of the system will be

(a) –8   (b) Zero

(c) 10   (d) –10

116. The fundamental unit of enthalpy is

(a) MLT^{-2} (b) $ML^{-2}T^{-1}$

(c) ML^2T^{-2} (d) ML^3T^{-2}

117. Heat flows between two reservoir having temperatures 1000 K and 500 K respectively. If the entropy change of the cold reservoir is 10 kJ/K, then what is the entropy change for the hot reservoir

(a) –10 kJ/K   (b) –5 kJ/K

(c) 5 kJ/K   (d) 10 kJ/K

118. A gas chamber is divided into two parts by means of a partition wall on one side, Nitrogen gas at 2 bar pressure and 20°C is present, on the other side, Nitrogen as at 3.5 bar pressure and 35°C is present. The chamber is rigid and thermally insulated from the surroundings. Now if the partition is removed.

(a) High pressure Nitrogen will get cooled

(b) Work will be done on low pressure Nitrogen

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(c) Mechanical work will be done at the expense of internal energy

(d) Internal energy of Nitrogen will be conserred

119. In a cyclic heat engine operating between a source temperature of $600°C$ and a sink temperature of $20°C$, the least rate of heat rejection per kW net output of the engine is

(a) 0.460 kW   (b) 0.588 kW

(c) 0.505 kW   (d) 0.650 kW

120. Which one of the following is the correct statement? Two adiabatic will

(a) intersect at absolute zero temperature

(b) never intersect

(c) become orthogonal at absolute zero temperature

(d) become parallel at absolute zero temperature

121. The thermal efficiency of the hypothetical heat engine cycle shown in the given figure is
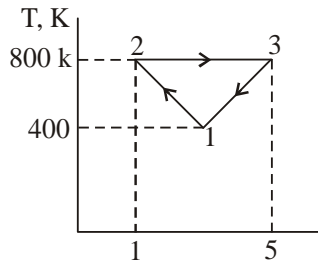
(a) 0.5   (b) 0.45

(c) 0.35   (d) 0.25

122. Dryness fraction of steam means the mass ratio of

(a) Wet steam to dry steam

(b) Dry steam to water particles in steam

(c) Water particles to total steam

(d) Dry steam to total steam

123. Availability function for a closed system is expressed as

(a) $\phi = u + p_0 v - T_0 ds$

(b) $\phi = du + p_0 dv + T_0 ds$

(c) $\phi = du + p_0 dv - T_0 ds$

(d) $\phi = u + p_0 v + T_0 ds$

124. The 'bath-tub' curve indicates failure probability. Which stage is NOT normally associated with the bathtub curve?

(a) 'Pulling the plug' where production is halted due to unacceptable level of failures

(b) 'Wear-out' where failure increases due to age

(c) 'Normal-life' where few failures occur

(d) 'Infant-mortaility' where failures occur early

125. Failure mode and effect analysis (FMEA) provide a checklist procedure. Which of the following questions is NOT likely to feature on the checklist?

(a) What would be the cost of avoiding failure be

(b) What is the likehood that failure will occur

(c) What would the consequences of the failure be

(d) How likely is such a failure to be detected before it affects the customer

126. Total productive maintenance (TPM) has five goals. Which of the following is NOT a goal to TPM?

(a) Improve equipment effectiveness

(b) Train all staff in relevant maintenance

(c) Achieve autonomous maintenance

(d) Focus preventative maintenance where failure is most likely to occur

127. Failure detection normally does NOT include which one of the following techniques?

(a) Lie detector tests

(b) Focus surveys

(c) Questionnairs

(d) Complaint cards/feedback sheets

128. The pressure angle in case of gears is

(a) The angle between the line of action and the common tangent to the pitch surface in the plane of rotation

(b) The angle between the two pitch points

(c) The angle between normal to the dedendum at the pitch point and tangent dedendum at

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the same point

(d) The angle of obliquity between the tangent drawn at the point of contact of the two mating gears

129. What is tooth fillet radius in case of gear?

(a) Pitch circle of teeth

(b) Top side of tooth

(c) Addendum + dedendum of teeth

(d) Radius that connects the root circle to the profile of the tooth

130. Which one of the following is a criterion in the design of hydrodynamic journal bearings?

(a) Sommerfield number

(b) Rating life

(c) Specific dynamic capacity

(d) Rotation factor

131. A circular bar moving in a round hole is an example of

(a) incompletely constrained motion

(b) partially constrained motion

(c) completely constrained motion

(d) successfully constrained motion

132. The Hooke's joint consists of

(a) two forks   (b) one fork

(c) three forks   (d) four forks

133. It is required to connect two parallel shafts, the distance between whose axes is small and variable. The shafts are coupled by

(a) Universal joint

(b) Knuckle joint

(c) Oldham's coupling

(d) Flexible coupling

134. Fluctuation of energy of an engine is the

(a) variation of energy above and below the mean resisting torque line

(b) ratio of the maximum and minimum energies

(c) difference between the maximum and minimum energies

(d) ratio of the maximum fluctuation of energy to the work done per cycle

135. The term "effort of governor" refers to

(a) centrifugal force of balls

(b) useful power developed

(c) force acting on sleeve for given % change of speed

(d) minimum force required on sleeve for % change of speed

136. According to law of gearing

(a) teeth should be of involute type

(b) clearance between mating teeth should be provided

(c) dedendum should be equal to 1.157 m

(d) teeth should be of cycloidal type

137. Tooth interference in an external involute spur gear pair can be reduced by

(a) decreasing centre distance between gear pair

(b) decreasing module

(c) decreasing pressure angle

(d) increasing number of gear teeth

138. The number of degrees of freedom for below mentioned arrangement is
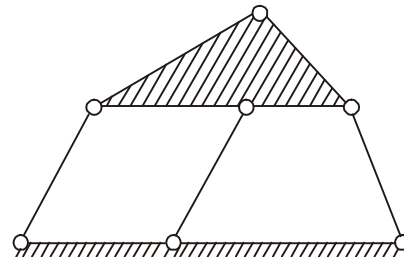
(a) 0   (b) 1

(c) 2   (d) 3

139. Velocity of piston at inner dead centre is

(a) Maximum   (b) Minimum

(c) Zero   (d) Unpredictable

140. Angle of obliquity is kept small

(a) To provide greater torque

(b) To avoid interference

(c) For low power loss

(d) To avoid larger thrusts

141. For the system described by $\dot{X} = AX$ match List-

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I (Matrix A) with List-II (Position of eigen values) and select the correct answer:

List-I

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

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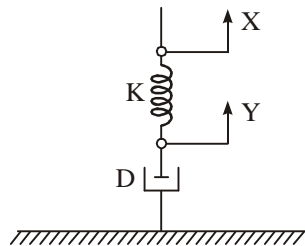D. $\begin{bmatrix} 1 & 0 \\ 2 & 4 \end{bmatrix}$

List-II

1. One eigen values at the origin

2. Both the eigen values in the LHP

3. Both the eigen values in RHP

4. Both the eigen values on the imaginary axis

Codes:

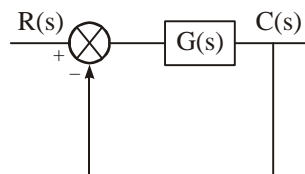|	A	B	C	D
(a)	2	1	3	4
(b)	2	1	4	3
(c)	1	2	4	3
(d)	1	2	3	4

142. The mechanical system shown below has its pole(s) at

(a) –K/D
(b) –K
(c) –DK
(d) O, –K/D

143. Consider the unity feedback system with

$G(s) = \dfrac{2}{s(s+1)(2s+1)}$. What is the gain margin of the system?


(a) 3/4
(b) 4/3
(c) 1/2
(d) 3/5

144. In case of d.c. servo-motor the back-emf is equivalent of an "electric friction" which tends to

(a) improve stability of the motor

(b) slowly decrease stability of the motor

(c) very rapidly decrease stability of the motor

(d) have no effect on stability

145. What is the characteristic of a good control system?

(a) Sensitive to parameter variation

(b) Insensitive to input command

(c) Neither sensitive to parameter variation nor sensitive to input commands

(d) Insensitivity to parameter variation but sensitive to input commands

146. The circuit diagram of an electrical network is given in figure. What type of compensator is this?
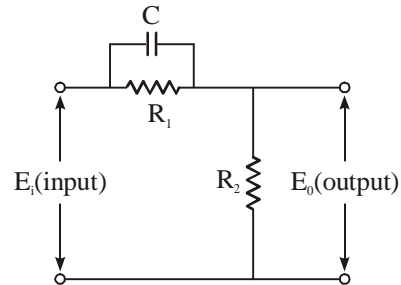
(a) Phase lag compensator

(b) Phase lead compensator

(c) Lag-lead compensator

(d) Neither phase lead nor phase lag compensator

147. *Statement (I) :* A derivative controller produces a control action for constant error only.

Statement (II) : The PD controller increases the damping ratio and reduces the peak overshoot.

(a) Both Statement (I) and Statement (II) are individually true and Statement (II) is the

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correct explanation of Statement (I).

(b) Both Statement (I) and Statement (II) are individually true but Statement (II) is **not** the correct explanation of Statement (I).

(c) Statement (I) is true but Statement (II) is false.

(d) Statement (I) is false but Statement (II) is true.

148. In a servo-system, the device used for providing derivative feedback is known as

  (a) Synchro   (b) Servomotor

  (c) Potentiometer   (d) Tachogenerator

149. In order to improve the system response transient behavior, the type of controller used is

  (a) Phase lead controller

  (b) Phase lag controller

  (c) PI controller

  (d) P controller

150. Analysis of incident that have customers either particular satisfaction or dissatisfaction is

  (a) Failure mode and effect analysis

  (b) Critical incident analysis

  (c) Product liability

  (d) Complaint analysis

❑❑❑

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ANSWERS KEY

1. *Ans.(a)*
2. *Ans.(d)*
3. *Ans.(b)*
4. *Ans.(d)*
5. *Ans.(c)*
6. *Ans.(d)*
7. *Ans.(c)*
8. *Ans.(c)*
9. *Ans.(c)*
10. *Ans.(b)*
11. *Ans.(b)*
12. *Ans.(d)*
13. *Ans.(a)*
14. *Ans.(b)*
15. *Ans.(c)*
16. *Ans.(d)*
17. *Ans.(c)*
18. *Ans.(d)*
19. *Ans.(a)*
20. *Ans.(a)*
21. *Ans.(d)*
22. *Ans.(d)*
23. *Ans.(d)*
24. *Ans.(b)*
25. *Ans.(d)*

$$Eu = \sqrt{\frac{F_i}{F_p}} = \sqrt{\frac{\rho V^2 L^2}{PL^2}} = \frac{V}{\sqrt{P/\rho}}$$

26. *Ans.(c)*

$$R = 10 \text{ cm}, U_{max} = 1 \text{ m/s}, r = 5 \text{ cm}$$

$$u = U_{max} \times \left(1 - \frac{r^2}{R^2}\right)$$

$$u = 1 \times \left(1 - \frac{25}{100}\right)$$

$$= 0.75 \text{ m/s}$$

27. *Ans.(c)*
28. *Ans.(b)*
29. *Ans.(c)*
30. *Ans.(b)*
31. *Ans.(d)*

$$P = 2515 \text{ kW}$$

$$N = 240 \text{ rpm}$$

$$P = T \times \frac{2\pi N}{60}$$

$$T = 100 \text{ kN-m}$$

32. *Ans.(a)*

33. *Ans.(b)*
34. *Ans.(b)*
35. *Ans.(d)*
36. *Ans.(d)*
37. *Ans.(d)*
38. *Ans.(d)*

$$P \propto V^2 \propto Q^2$$

39. *Ans.(c)*
40. *Ans.(d)*
41. *Ans.(b)*
42. *Ans.(a)*
43. *Ans.(b)*
44. *Ans.(c)*
45. *Ans.(a)*
46. *Ans.(c)*
47 *Ans.(a)*
48. *Ans.(a)*
49. *Ans.(b)*
50. *Ans.(c)*
51. *Ans.(c)*
52. *Ans.(d)*
53. *Ans.(b)*

$$\text{The expansion ratio} = \frac{1}{\text{Cutt-off Ratio}}$$

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$= \dfrac{1}{0.35} = 2.85$

54. *Ans.(a)*

55. *Ans.(d)*

56. *Ans.(a)*

57. *Ans.(d)*

Enthalpy drop in moving blades

$= \dfrac{V^2_{r_2} - V^2_{r_1}}{2 \times 1000} = \dfrac{152^2 - 79^2}{2000}$

$= 8.43$ kJ/kg

Degree of reaction $= \dfrac{8.43}{14.1}$

$= 0.597 \approx 0.6$

58. *Ans.(d)*

The air fuel rating might vary from about 60 : 1 to 120 : 1 for simple gas turbines and from 100 : 1 to 200 : 1 if a heat exchanger is employed.

59. *Ans.(c)*

Expansion joints in steel pipe lines are installed to take stresses away from flanges and fittings and also to permit expansion of pipes due to temperature rise.

60. *Ans.(a)*

61. *Ans.(a)*

$O_2 = 9.6$ means excess air is used.

62. *Ans.(b)*

63. *Ans.(c)*

Since CO does not have hydrogen content :

The HCV and LCV are same

64. *Ans.(a)*

65. *Ans.(a)*

66. *Ans.(a)*

67. *Ans.(a)*

68. *Ans.(b)*

69. *Ans.(a)*

70. *Ans.(b)*

Since the cube is constrained in all direction therefore

$\varepsilon_x = \varepsilon_y = \varepsilon_z = 0$

$\varepsilon_x = 0$

$L\alpha T - \dfrac{\sigma L}{E} + \dfrac{\mu \sigma L}{E} + \dfrac{\mu \sigma L}{E} = 0$

$\alpha T - \dfrac{\sigma}{E}(1 - 2\mu) = 0$

$\sigma = \dfrac{\alpha TE}{(1 - 2\mu)}$

71. *Ans.(c)*

72. *Ans.(b)*

73. *Ans.(c)*

74. *Ans.(b)*

75. *Ans.(b)*

76. *Ans.(a)*

77. *Ans.(c)*

78. *Ans.(b)*

79. *Ans.(a)*

80. *Ans.(d)*

81. *Ans.(a)*

82. *Ans.(a)*

83. *Ans.(b)*

Machining time, $T_m = \dfrac{L}{fN} = \dfrac{72}{80 \times 0.3} = 3$ min.

84. *Ans.(c)*

85. *Ans.(d)*

We know that,

$VT^n = C$

$V_1 T_1^{0.25} = \dfrac{V_1}{2}(T_2)^{0.25}$

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$$\left(\frac{T_1}{T_2}\right)^{1/4} = \frac{1}{2}$$

$$\frac{T_1}{T_2} = \left(\frac{1}{2}\right)^4 = \frac{1}{16}$$

$$T_2 = 16T_1$$

86. *Ans.(a)*

87. *Ans.(b)*

88. *Ans.(b)*

89. *Ans.(a)*

90. *Ans.(c)*

91. *Ans.(a)*

92. *Ans.(d)*

93. *Ans.(c)*

94. *Ans.(c)*

95. *Ans.(b)*

96. *Ans.(a)*

97. *Ans.(d)*

98. *Ans.(a)*

99. *Ans.(a)*

100. *Ans.(d)*

101. *Ans.(d)*

102. *Ans.(b)*

103. *Ans.(c)*

104. *Ans.(a)*

105. *Ans.(a)*

106. *Ans.(c)*

107. *Ans.(a)*

108. *Ans.(a)*

109. *Ans.(c)*

110. *Ans.(c)*

111. *Ans.(d)*

112. *Ans.(d)*

113. *Ans.(c)*

114. *Ans.(c)*

Net work output

$$= 3 + 10 - 8 = 5 \text{ unit}$$

Heat added

$$= 30 + 5 = 35 \text{ unit}$$

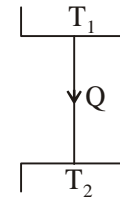Therefore efficiency,

$$\eta = \frac{5}{35} \times 100\% = 14.33\ \%$$

115. *Ans.(b)*

Internal energy is a poroperty of a system

So $\oint du = 0$

116. *Ans.(c)*

117. *Ans.(b)*

$$\Delta S_2 = \frac{+Q}{500} = 10$$

or $Q = 500 \text{ kJ}$

$$\Delta S_1 = \frac{-Q}{1000} = \frac{-5000}{1000} = -5 \text{ kJ/K}$$

∴ Heat added to the system is +Ve

Heat rejected from the system is –Ve

118. *Ans.(a)*

119. *Ans.(c)*

Reversible engine has maximum efficiency where

$$\frac{Q_1}{T_1} = \frac{Q_2}{T_2} = \frac{Q_1 - Q_2}{T_1 - T_2} = \frac{W}{T_1 - T_2}$$

∴ Least heat rejection per kW net output,

$$Q_2 = \frac{W}{T_1 - T_2} \times T_2$$

$$= \frac{1}{873 - 293} \times 293 = 0.505 \text{ kW}$$

120. *Ans.(b)*

121. *Ans.(d)*

$$h = \frac{\text{Work done}}{\text{Heat added}} = \frac{\text{Area } 1 - 2 - 3}{\text{Area under curve } 2 - 3}$$

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$$= \frac{\frac{1}{2} \times (5-1) \times (800-400)}{(5-1) \times 800} = 0.25$$

122. *Ans.(d)*

123. *Ans.(a)*

124. *Ans.(a)*

125. *Ans.(a)*

126. *Ans.(d)*

127. *Ans.(a)*

128. *Ans.(a)*

129. *Ans.(d)*

130. *Ans.(a)*

131. *Ans.(a)*

132. *Ans.(a)*

133. *Ans.(c)*

134. *Ans.(a)*

135. *Ans.(c)*

136. *Ans.(d)*

137. *Ans.(d)*

138. *Ans.(a)*

139. *Ans.(c)*

140. *Ans.(d)*

141. *Ans. (b)*

Eigen values are the roots of $|sI - A| = 0$

Let
$$A = \begin{bmatrix} -1 & 2 \\ 0 & -2 \end{bmatrix}$$

$$sI - A = \begin{bmatrix} s+1 & -2 \\ 0 & s+2 \end{bmatrix}$$

$$|sI - A| = (s + 1)(s + 2)$$

$$|sI - A| = 0$$

$$\Rightarrow \quad (s + 1)(s + 2) = 0$$

$$\Rightarrow \quad s = -1, -2$$

Thus both the eigen values are in the LHP

Let
$$A = \begin{bmatrix} -1 & -2 \\ -2 & -4 \end{bmatrix}$$

$$sI - A = \begin{bmatrix} s+1 & 2 \\ 2 & s+2 \end{bmatrix}$$

$$|sI - A| = 0$$

$$\Rightarrow \quad (s + 1)(s + 4) - 4 = 0$$

$$\Rightarrow \quad s^2 + 5x + 4 - 4 = 0$$

$$\Rightarrow \quad s(s + 5) = 0$$

$$\Rightarrow \quad s = 0, -5$$

Thus one eigen value is at the origin.

Let
$$A = \begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

$$sI - A = \begin{bmatrix} s & 1 \\ -1 & s \end{bmatrix}$$

$$|s| - A = 0$$

$$\Rightarrow \quad s^2 + 1 = 0$$

$$\Rightarrow \quad s = \pm j\,1$$

Thus both the eigen values are on the imaginary axis.

Let
$$A = \begin{bmatrix} 1 & 0 \\ 2 & 4 \end{bmatrix}$$

$$sI - A = \begin{bmatrix} s-1 & 0 \\ -2 & s-4 \end{bmatrix}$$
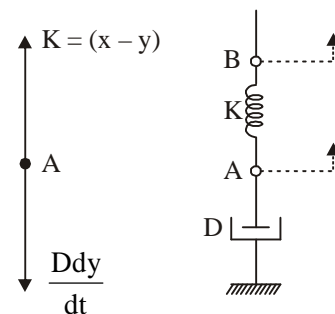
$$|sI - A| = 0$$

$$\Rightarrow (s - 1)(s - 4) = 0$$

$$\Rightarrow \quad s = 1, 4$$

Thus both the eigen values are in the RHP.

142. *Ans. (a)*

F.B.D. of point A :

So, $\quad K(x - y) = \dfrac{Ddy}{dt}$

Taking Laplace transform

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$K\{X(s) - Y(s)\} = DsY(s)$

$\Rightarrow (Ds + K) Y(s) = KX(s)$

$\Rightarrow \quad \dfrac{Y(s)}{X(s)} = \dfrac{K}{D\left(s + \dfrac{K}{D}\right)}$

Thus the pole of the system is at

$$s = -\dfrac{K}{D}$$

143. *Ans. (a)*

$$\angle G(j\omega) = -90° - \tan^{-1}\omega - \tan^{-1}$$

$$2\omega = -180°$$

$\Rightarrow \quad \tan^{-1}\left(\dfrac{\omega + 2\omega}{1 - 2\omega^2}\right) = 90°$

$\Rightarrow \qquad 1 - 2\omega^2 = 0$

$\Rightarrow \qquad \omega = \dfrac{1}{\sqrt{2}}$ rad/s

$$|G(j\omega)|_{\omega = \frac{1}{\sqrt{2}}} = \dfrac{2}{\dfrac{1}{\sqrt{2}} \cdot \sqrt{\dfrac{1}{2}+1} \cdot \sqrt{\dfrac{4}{2}+1}}$$

$$= \dfrac{2\sqrt{2}}{\dfrac{\sqrt{3}}{\sqrt{2}} \cdot \dfrac{\sqrt{6}}{\sqrt{2}}} = \dfrac{4}{3}$$

$$\text{Gain margin} = \dfrac{1}{|G(j\omega)|}\bigg|_{\omega = \omega_{pc}} = \dfrac{3}{4}$$

So phase angle is independent of ζ.

144. *Ans. (a)*

145. *Ans. (d)*

In a good control system, output is sensitive to input variations but insensitive to parameter variations.
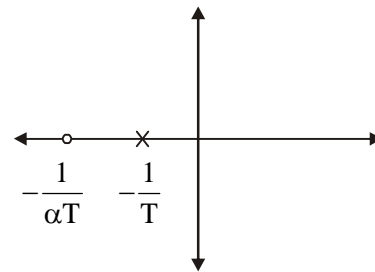
146. *Ans. (b)*

For the given circuit

$$\dfrac{E_0(s)}{E_i(s)} = \dfrac{R_2(1 + R_1 Cs)}{R_1 + R_2\left[1 + \dfrac{R_1 R_2 Cs}{R_1 + R_2}\right]}$$

$\Rightarrow \qquad \dfrac{E_0(s)}{E_i(s)} = \dfrac{\alpha(1 + Ts)}{(1 + \alpha Ts)}$

Where $\qquad \alpha = \dfrac{R_2}{R_1 + R_2} < 1$

and $\qquad T = R_1 C$

Hence given circuit represents a phase lead compensator.

147. *Ans. (d)*

The control action produced by derivative controller is not limited to constant errors only.

PD controller affects the transient response.

By PD controller $\xi \uparrow$

$$M_P = e^{-\xi\pi} \Big/ \sqrt{1 - \xi^2}$$

So $\qquad \xi \uparrow \Rightarrow M_P \downarrow$

148. *Ans. (d)*

149. *Ans. (a)*

Phase lead controller $\Rightarrow$ Improve transient response.

Phase lag controller $\Rightarrow$ Improve steady state response.

150. *Ans. (b)*

❏❏❏

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