Booklet Serial No.   **41045**

SERIES : I

DO NOT BREAK THE SEAL OF THE BOOKLET UNTIL YOU ARE TOLD TO DO SO

QUESTION BOOKLET

Subjects : General English, General Knowledge & Aptitude, Mechanical Engineering / Electrical Engineering

Full Marks : 350   **Time Allowed : 2½ Hours**

Read the following instructions carefully before you begin to answer the questions.

INSTRUCTIONS TO CANDIDATES

1. This Booklet contains **175 questions** to be answered in a separate OMR Answer Sheet using Black Ballpoint Pen in the following three Parts :

Part—A	:	General English	:	25 questions
Part—B	:	General Knowledge & Aptitude	:	50 questions
Part—C	:	[Choose any ONE subject from the following] Mechanical Engineering / Electrical Engineering	:	100 questions

2. **All** questions are compulsory.

3. You will be supplied the Answer Sheet separately by the Invigilator. You must complete the details of particulars asked for.

4. Answer must be shown by completely blackening the corresponding circle in the Answer Sheet against the relevant question number by Black Ballpoint Pen. OMR Answer Sheet without marking Series shall not be evaluated.

   Example :
   Suppose the following question is asked :

   The Capital of Meghalaya is

   (A) Guwahati

   (B) Kohima

   (C) Shillong

   (D) Delhi

   You will have four alternatives in the Answer Sheet for your response corresponding to each question of the Question Booklet as below :

   Ⓐ Ⓑ Ⓒ Ⓓ

   In the above illustration, if your chosen response is alternative (C), i.e., Shillong, then the same should be marked on the Answer Sheet by blackening the relevant circle with a Black Ballpoint Pen only as below :

   Ⓐ Ⓑ ● Ⓓ

   The example shown above is the only correct method of answering.

5. Answer the questions as quickly and as carefully as you can. Some questions may be difficult and others easy. Do not spend too much time on any one question.

6. There will NOT be any negative marking for wrong answers.

7. The Answer Sheet must be handed over to the Invigilator before you leave the Examination Hall.

8. No Rough Work is to be done on the Answer Sheet. Space for Rough Work has been provided in the Question Booklet.

SEAL

PART—A : GENERAL ENGLISH

(*Marks* : 50)

Each question carries **2** marks

Directions (Q. Nos. 1–5) :
Fill in the blanks with appropriate answers from the given options.

1. He was born _____ a small village _____ Malabar.

    (A) at/in

    (B) near/at

    (C) in/at

    (D) at/near

2. The express departs _____ 3 p.m. _____ Delhi.

    (A) by/at

    (B) at/from

    (C) till/from

    (D) on/it

3. I saw him felling a big tree _____ a hatchet.

    (A) with

    (B) like

    (C) through

    (D) in

4. _____ Rostam and Sohrab, there were three boys present.

    (A) With

    (B) Besides

    (C) Beside

    (D) Among

5. An old feud existed _____ the two families.

    (A) among

    (B) between

    (C) with

    (D) in

Directions (Q. Nos. 6–20) :
Choose the correct options to fill in the blanks.

6. He could not be seen. He was _____.

    (A) invincible

    (B) invisible

    (C) camouflaged

    (D) nowhere

7. Jane left her place of birth to go to another country. Jane is a/an _____.

    (A) emigrant

    (B) immigrant

    (C) tourist

    (D) alien

8. Tom has a hobby of collecting postage stamps. He is a/an _____.

(A) philanthropist

(B) collector

(C) philatelist

(D) antiquarian

9. A person's life history written by him or her is a/an _____.

(A) biography

(B) memoir

(C) journal

(D) autobiography

10. Mr. Mehta sends the goods he produces in India to Europe and sells from there. Mr. Mehta is a/an _____.

(A) exporter

(B) importer

(C) wholesaler

(D) retailer

11. What _____ beautiful scene this is!

(A) the

(B) a

(C) an

(D) None of the above

12. For Brutus is _____ honourable man.

(A) an

(B) the

(C) a

(D) None of the above

13. He likes to picture himself as _____ original thinker.

(A) the

(B) a

(C) an

(D) None of the above

14. _____ umbrella is of no avail against _____ thunderstorm.

(A) The/the

(B) An/a

(C) A/a

(D) An/the

15. English is _____ language of _____ people of England.

(A) a/the

(B) the/the

(C) an/the

(D) a/a

16. I brought _____ horse, _____ ox and _____ buffalo.

(A) the/the/the

(B) a/an/a

(C) a/a/a

(D) the/an/the

17. _____ Ganga is _____ sacred river.

(A) The/a

(B) The/an

(C) A/a

(D) An/an

18. Yesterday _____ European called at my office.

(A) a

(B) an

(C) the

(D) None of the above

19. _____ lion is _____ king of beasts.

(A) The/the

(B) A/the

(C) An/the

(D) A/a

20. _____ able man has not always a distinguished look.

(A) The

(B) A

(C) An

(D) None of the above

Directions (Q. Nos. 21–25) :
Choose the correct options appropriate for the given idioms.

21. To eat humble pie

(A) To apologize humbly

(B) To eat pie made by humble people

(C) To humbly accept failure

(D) To be humble

22. Won his laurels

(A) Bestowed a huge garden

(B) Acquired distinction or glory

(C) Acquired great wealth

(D) Achieved the impossible

23. Hand and glove

(A) Intimate terms

(B) False friends

(C) Guarded companions

(D) None of the above

24. Hit the nail on the head

(A) Precise aim

(B) Said or done exactly the right thing

(C) Work done in carpentry

(D) None of the above

25. The gift of the gab

(A) A talent for jabbing

(B) A talent for speaking

(C) A talent for social network

(D) None of the above

PART—B : GENERAL KNOWLEDGE & APTITUDE

(*Marks* : 100)

Each question carries **2** marks

26. The longest river of Africa, the Nile, originates in Burundi, flows a long way and finally drains into the
    (A) Mediterranean Sea
    (B) Arabian Sea
    (C) Black Sea
    (D) Red Sea

27. Which of the following is a classical dance from of North India?
    (A) Kathakali
    (B) Kathak
    (C) Kuchipudi
    (D) Bharatanatyam

28. Which is the first indigenous silent film?
    (A) *Alam Ara*
    (B) *Raja Harishchandra*
    (C) *Mother India*
    (D) *Bhakta Prahlada*

29. Who among the following is the youngest Nobel Prize winner?
    (A) Malala Yousafzai
    (B) Paul Dirac
    (C) Werner Heisenberg
    (D) Abhijit Vinayak Bandopadhyay

30. Which technology company has collaborated with the National Skill Development Corporation (NSDC) to provide digital skills to women?
    (A) Facebook   (B) Microsoft
    (C) Verizon   (D) Cognizant

31. Which of the following monsoons accounts for most of the rainfall in India?
    (A) North-East Monsoon
    (B) South-West Monsoon
    (C) South-East Monsoon
    (D) East Asian Monsoon

32. In which of the following States are the Ajanta Caves situated?
    (A) Karnataka
    (B) Uttar Pradesh
    (C) Maharashtra
    (D) Madhya Pradesh

33. Which Indian-origin nurse has been conferred with the Singapore President's Award for COVID-19 Services?
    (A) Kala Narayanasamy
    (B) Bhasha Mukherjee
    (C) Ankit Bharat
    (D) Uma Madhusudan

34. Hemoglobin in humans has the highest affinity for which of the following gases?
    (A) Methane
    (B) Carbon monoxide
    (C) Nitrous oxide
    (D) Carbon dioxide

35. Which among the following is called the 'Queen of Spices'?
    (A) Cardamom   (B) Clove
    (C) Turmeric   (D) Coriander

36. A projectile will achieve maximum horizontal range when it is projected at which angle?

(A) 90°   (B) 60°

(C) 45°   (D) 30°

37. BSI scientists have discovered a new species of parasitic flowering plant named *Gleadovia konyakianorum* called so in honour of the Konyak tribe of which community?

(A) Jarawa   (B) Khasi

(C) Naga   (D) Bhil

38. How many types of elements are there in glucose?

(A) 3   (B) 12

(C) 45   (D) 6

39. The Diamond Princess cruise ship, which witnessed the largest corona-virus outbreak, was quarantined in which country?

(A) Australia   (B) China

(C) South Korea   (D) Japan

40. The Lotus Temple in Delhi is a place of worship for people of which faith?

(A) Hindu   (B) Bahái

(C) Sikh   (D) Buddhist

41. The implementation of which among the following programmes is/was based upon the concept of the Self-Help Groups (SHGs)?

(A) National Rural Employment Guarantee Act

(B) Sampoorna Grameen Rozgar Yojana

(C) Swarna Jayanti Gram Swarozgar Yojana

(D) National Food for Work Programme

42. Which of the following decides the allocation of the shares in tax proceeds?

(A) Parliament

(B) Finance Commission

(C) Ministry of Finance

(D) Public Accounts Committee

43. Who wrote the book, *New Dimensions of India's Foreign Policy*?

(A) Atal Bihari Vajpayee

(B) Abul Kalam Azad

(C) Amit Chaudhuri

(D) Raghuram Rajan

44. The first Industrial Revolution took place in

(A) England

(B) USA

(C) France

(D) Germany

45. Which of the following places was the main center of the Dutch settlement in India?

(A) Masulipatnam

(B) Serampore

(C) Chandannagar

(D) Kolkata

46. The highest railway bridge in the world is to be constructed in which State/UT?

(A) Himachal Pradesh

(B) Uttarakhand

(C) Sikkim

(D) Jammu and Kashmir

47. The 'Walker Cup' is associated with which sport?

(A) Cricket

(B) Fencing

(C) Golf

(D) Hockey

48. 'Grand Renaissance Dam' is located in which country?

(A) Nigeria

(B) Sudan

(C) Egypt

(D) Ethiopia

49. When is the 'International Day for the Conservation of the Mangrove Ecosystem' observed annually?

(A) July 23

(B) July 26

(C) July 29

(D) July 31

50. Which freedom fighter suffered fatal injuries during a demonstration against the 'Simon Commission'?

(A) Lala Lajpat Rai

(B) Bhagat Singh

(C) Bal Gangadhar Tilak

(D) Chandrashekhar Azad

51. The sum of three consecutive integers is 72. What is the sum of the squares of the first and third numbers?

(A) 1254   (B) 1105

(C) 1451   (D) 1154

52. What is the missing letter in the following series?

b e h k n ? t

(A) q   (B) r

(C) s   (D) u

53. A number increases from 20 to 30 and then decreases from 30 to 20. Compare the percent of increase from 20 to 30 and that of the decrease from 30 to 20. From the following which of the given statements is true?

(A) Percent decrease is less than the percent increase.

(B) Percent decrease is more than the percent increase.

(C) Percent increase is less than the percent increase.

(D) Data insufficient

54. If you unscramble the letters YKANE, you will get the name of a

(A) mountain pass

(B) warrior

(C) flower

(D) country

55. There are twenty-four students in a certain class. For every nine girls, there are three boys. How many girls and how many boys are there in the class?

(A) 19 and 5   (B) 18 and 6

(C) 15 and 9   (D) 14 and 10

56. Five teams from Delhi's schools are participating in a summer school football league. If each team plays the other teams 2 times, then the total number of games in the league will be

(A) 10   (B) 20
(C) 30   (D) 40

57. Sonam invested ₹ 1,20,000 for buying 1000 BNB shares which were sold at a premium of 20%. What is the face value of the share?

(A) 100   (B) 120
(C) 144   (D) 96

58. The product of 3×2 matrix and 2×3 matrix will result in what order matrix?

(A) 3×2 (B) 2×2
(C) 2×3 (D) 3×3

59. When a die is rolled, the probability of landing with 2 is

(A) 3/6   (B) 1/6
(C) 2/6   (D) 5/6

60. The angle x at which the values of $\sin x$ and $\cos x$ become equal is

(A) 90°   (B) 60°
(C) 45°   (D) 30°

61. A wall clock gains 2 seconds in every 1 minute. Assuming that it was set right at 8 a.m. and if in the evening of the same day when the wall clock indicated half past 8 o'clock, the correct time is

(A) 8:25 p.m.   (B) 8:05 p.m.
(C) 7:25 p.m.   (D) 7:00 p.m.

62. Karna can do a piece of work in 6 hours; Dorbi and Sonal together can do it in 2 hours, while Karna and Sonal together can do it in 3 hours. How long will Dorbi alone take to do it?

(A) 1 hour   (B) 2 hours
(C) 3 hours   (D) 4 hours

63. The price of a commodity increased 8 points, then decreased 13 points, and then increased 9 points. If the commodity price before the changes was x points, then which of the following was the commodity price, in points, after the changes?

(A) $x - 5$ (B) $x - 4$
(C) $x + 5$ (D) $x + 4$

64. Which number should be next in the following series?

$$1 - 1 - 2 - 3 - 5 - 8 - 13$$

(A) 21   (B) 26
(C) 31   (D) 41

65. Rita's father is four times as old as her. In 20 years, he will be only twice as old as her. How old is her father and how old is she?

(A) 32 and 8   (B) 40 and 10
(C) 36 and 9   (D) 60 and 15

66. Your student is writing a letter of invitation. Which of the following words would you recommend for him to replace the underlined words in the given sentence?

"The programme will begin at 9:00 a.m."

(A) seize   (B) starts
(C) begun   (D) commence

67. Two numbers are in the ratio 5 : 4 and the difference between them is 10. What is the larger number?

(A) 30   (B) 40
(C) 50   (D) 60

68. In a class of 8 students, the test scores are 10, 20, 15, 25, 30, 15, 25, 36 out of 50 in Geography subject. What is the average score of the class?

(A) 20   (B) 21
(C) 22   (D) 25

69. Find the missing letter in the sequence :

F K O R T __

(A) S (B) T
(C) U (D) V

70. In a class of 45 students, 40% are boys. Amongst the girls, 7 like to read and 6 like to watching movies. Of the remaining girls, 50% of them like to read as well as watch movies. How many girls like both reading and watching movies?

(A) 5 (B) 7
(C) 13 (D) 15

71. Find the odd one out.

(A) 144 (B) 289
(C) 312 (D) 729

72. Ramu, Sita, Kavita and Kanta speak many languages. Ramu and Sita speak Chinese, whereas the others speak Spanish. Sita and Kanta speak French. Everyone except Ramu speaks Hindi. Who only speaks Spanish and Hindi?

(A) Ramu

(B) Kavita

(C) Sita

(D) Kanta

73. Karan is heavier than Sonal. Dorji weighs less than Sonal. Pawan is heavier than Dorji but lighter than Sonal. Then which of the following statements is **not** true?

(A) Karan weighs more than Dorji.

(B) Sonal weighs less than Karan.

(C) Dorji weighs more than Karan.

(D) Dorji is the lightest of all.

74. If Russel is older than Candy, Candy is older than Peter, Peter is younger than Russel and Sandy is older than Russel, then a listing from oldest to youngest would be

(A) Sandy, Russel, Candy and Peter

(B) Russel, Sandy, Candy and Peter

(C) Candy, Russel, Sandy and Peter

(D) Peter, Russel, Candy and Sandy

75. Find out which of the following figures can be formed from the pieces given in Figure (X) :
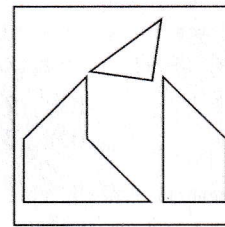
(X)
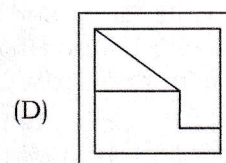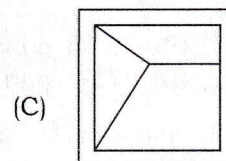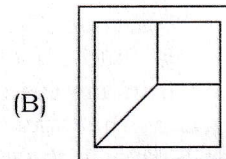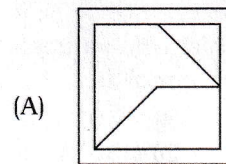
(A)

(B)

(C)

(D)

PART—C [Choose any ONE subject from the following]

MECHANICAL ENGINEERING

(*Marks* : 200)

Each question carries **2** marks

76. Rolling friction is

(A) greater than static friction

(B) greater than kinetic friction

(C) less than static and kinetic friction

(D) equal to kinetic friction

77. In a perfect truss, the number of members (m), joints (j) and reactions (r) are related by

(A) $m = 2j$

(B) $m = j + r$

(C) $m = 2j - r$

(D) $m = 3j - r$

78. The impulse-momentum principle is an expression of

(A) work-energy theorem

(B) Newton's second law

(C) conservation of momentum

(D) conservation of energy

79. A belt slipping over a pulley obeys

(A) Coulomb friction law

(B) Capstan equation

(C) Hooke's law

(D) Bernoulli's equation

80. The ratio of lateral strain to axial strain is

(A) Young's modulus

(B) shear modulus

(C) bulk modulus

(D) Poisson's ratio

81. For uniaxial tension, the maximum shear stress occurs at

(A) $0°$

(B) $90°$

(C) $45°$

(D) $30°$

82. The principal stresses can be graphically found using

(A) Mohr's circle

(B) Hooke's law

(C) Euler's formula

(D) Maxwell's theorem

83. In thin cylinders, hoop stress is

(A) twice the longitudinal stress

(B) half the longitudinal stress

(C) equal to radial stress

(D) zero

84. The shear force diagram is the derivative of

(A) load diagram

(B) stress distribution

(C) bending moment diagram

(D) deflection curve

85. The bending stress in a beam varies

(A) linearly across depth

(B) linearly from the neutral axis

(C) uniformly across the section

(D) parabolically

86. Euler's theory is valid for

(A) short columns

(B) columns under dynamic loads

(C) long, slender columns

(D) all columns

87. Deflection in a beam is calculated using

(A) bending equation

(B) moment-area method

(C) Mohr's circle

(D) torsion formula

88. Torsional shear stress in a circular shaft is maximum

(A) at the center

(B) along the neutral axis

(C) at the outer surface

(D) at 45° to axis

89. Energy methods in elasticity include

(A) Hooke's law

(B) Castigliano's theorem

(C) Euler's buckling

(D) Bernoulli's equation

90. Brinell hardness test uses

(A) diamond

(B) hardened steel ball

(C) pendulum

(D) cone indenter

91. In a four-bar mechanism, the link opposite to the shortest link is

(A) crank

(B) rocker

(C) coupler

(D) frame

92. The acceleration of a point on a link has

(A) radial component only

(B) radial and tangential components

(C) constant value

(D) tangential component only

93. The velocity ratio of a simple gear train is

(A) product of gear ratios

(B) sum of gear speeds

(C) number of intermediate gears

(D) difference in teeth

94. A governor controls

(A) speed directly

(B) fuel supply based on speed

(C) crank angle

(D) torque

95. Gyroscopic effect in a turning vehicle causes

(A) precession

(B) nutation

(C) vibration

(D) torsion

96. Critical damping results in

(A) sustained oscillation

(B) fastest return to equilibrium without oscillation

(C) no motion

(D) increasing amplitude

97. A rotating shaft experiences resonance when

(A) critical speed is reached

(B) RPM is zero

(C) it is horizontal

(D) damping is infinite

98. To reduce vibrations, we

(A) increase stiffness

(B) add damping

(C) reduce mass

(D) increase frequency

99. In sliding contact bearings, lubrication is essential to

(A) reduce temperature only

(B) increase friction

(C) minimize wear and friction

(D) transmit load

100. In a clutch, torque is transmitted by

(A) spring force

(B) axial movement

(C) frictional force

(D) gyroscopic effect

101. A spring stores

(A) kinetic energy

(B) potential energy due to inertia

(C) strain energy

(D) magnetic energy

102. Shaft design is governed by

(A) torsional and bending loads

(B) axial load only

(C) shear force only

(D) hoop stress

103. Rolling contact bearings fail due to

(A) fatigue

(B) compression

(C) tensile failure

(D) expansion

104. The *S-N* curve represents

(A) stress *vs.* number of cycles to failure

(B) strain *vs.* stress

(C) stiffness *vs.* load

(D) shape *vs.* natural frequency

105. In fluid statics, the pressure at a point in an incompressible fluid is

(A) same in all directions

(B) zero

(C) minimum at the top

(D) maximum at the bottom

106. Surface tension in a fluid is caused due to

(A) gravity

(B) viscosity

(C) cohesive forces between molecules

(D) pressure difference

107. In irrotational flow, the vorticity is

(A) constant

(B) maximum

(C) negative

(D) zero

108. Darcy-Weisbach equation is used to calculate the

(A) velocity of fluid in pipe

(B) pressure loss due to friction

(C) flow rate through nozzle

(D) compressibility factor

109. Mach number is the ratio of

(A) velocity to density

(B) pressure to velocity

(C) flow velocity to speed of sound

(D) temperature to velocity

110. Availability (exergy) is maximum when

(A) system is at ambient conditions

(B) system is at equilibrium

(C) work is done reversibly

(D) work is done irreversibly

111. A floating body is said to be stable if

(A) its center of gravity is above the metacenter

(B) its metacenter is above the center of gravity

(C) it has a higher density

(D) it has a lower weight

112. Volumetric efficiency of a compressor is maximum when

(A) compression is isentropic

(B) clearance volume is zero

(C) suction temperature is high

(D) pressure ratio is large

113. Which principle is used for the control volume approach in fluid mechanics?

(A) Reynolds' transport theorem

(B) Pascal's law

(C) Archimedes' principle

(D) Darcy's law

114. Which of the following equations represents the differential form of mass conservation?

(A) Navier-Stokes equation

(B) Continuity equation

(C) Bernoulli equation

(D) Euler equation

115. Bernoulli's equation is applicable only to

(A) compressible flows

(B) incompressible, inviscid and steady flows

(C) rotational flows

(D) viscous flows

116. Dew point is the temperature at which

(A) water boils

(B) air becomes saturated

(C) relative humidity is zero

(D) specific humidity increases

117. In vapor-compression cycle, heat is absorbed in

(A) compressor

(B) condenser

(C) expansion valve

(D) evaporator

118. The efficiency of dual cycle lies between

(A) Otto and Diesel cycles

(B) Carnot and Otto cycles

(C) Diesel and Carnot cycles

(D) Brayton and Rankine cycles

119. In fully developed laminar flow in a circular pipe, velocity profile is

(A) parabolic for compressible fluid only

(B) parabolic

(C) constant

(D) hyperbolic

120. The Reynolds' number indicates the

(A) compressibility of a fluid

(B) surface tension of a fluid

(C) ratio of inertial to viscous forces

(D) ratio of shear to pressure forces

121. The minor losses in a pipe system occur due to

(A) straight pipe sections

(B) fittings, bends and valves

(C) laminar flow

(D) flow velocity

122. Fins are used to

(A) increase thermal conductivity

(B) reduce conduction losses

(C) increase surface area for heat transfer

(D) reduce radiation

123. Lumped parameter analysis is valid when

(A) thermal conductivity is high

(B) Biot number < 0.1

(C) Fourier number > 1

(D) Biot number > 1

124. The thermal boundary layer develops due to

(A) temperature gradients in the fluid

(B) high pressure

(C) constant heat flux

(D) blackbody radiation

125. Nusselt number is the ratio of

(A) viscous to inertial forces

(B) convective to conductive heat transfer

(C) conductive to radiative heat transfer

(D) kinematic to dynamic viscosity

126. Radiative heat transfer occurs due to

(A) convection

(B) conduction

(C) electromagnetic waves

(D) fluids in motion

127. Stefan-Boltzmann law gives

(A) power radiated per unit area by a blackbody

(B) heat transfer by conduction

(C) convective heat transfer

(D) change in temperature

128. A thermodynamic system that exchanges neither matter nor energy is

(A) closed

(B) isolated

(C) open

(D) reversible

129. The second law of thermodynamics introduces the concept of

(A) enthalpy

(B) work

(C) entropy

(D) internal energy

130. Carnot efficiency depends on

(A) temperatures of heat reservoirs

(B) working substance

(C) type of gas

(D) compressor work

131. Irreversibility in a process is due to

(A) friction, heat transfer and mixing

(B) work input

(C) expansion only

(D) compression only

132. Maxwell relations are derived from

(A) Joule-Thomson equation

(B) fundamental thermodynamic equations

(C) Clausius inequality

(D) steam tables

133. The efficiency of the Brayton cycle increases with

(A) regeneration

(B) higher pressure drop

(C) reduced compression

(D) lower turbine inlet temperature

134. In gas turbines, reheat is used to

(A) cool the turbine

(B) reduce fuel use

(C) increase work output

(D) decrease pressure ratio

135. COP of a refrigeration cycle is defined as

(A) desired effect/work input

(B) work input/desired effect

(C) heat rejected/work

(D) work/heat rejected

136. In psychrometric chart, constant wet-bulb lines are

   (A) horizontal
   (B) nearly diagonal
   (C) vertical
   (D) curved

137. The process of sensible cooling shows

   (A) constant humidity ratio and decreasing dry-bulb temperature
   (B) decreasing humidity ratio
   (C) increasing specific volume
   (D) no change in enthalpy

138. In a reaction turbine

   (A) both pressure and velocity change across the rotor
   (B) only velocity changes
   (C) only pressure changes
   (D) no energy is extracted from fluid

139. Pearlite is a combination of

   (A) cementite and ferrite
   (B) alternate layers of ferrite and cementite
   (C) austenite and martensite
   (D) bainite and ferrite

140. In a eutectic phase diagram, the eutectic reaction involves

   (A) solid to solid transformation
   (B) liquid transforming to two solid phases
   (C) solid transforming to liquid and another solid
   (D) gas to solid transition

141. In the stress-strain diagram of ductile materials, the area under the curve represents

   (A) yield strength
   (B) toughness
   (C) stiffness
   (D) total energy absorbed until fracture

142. The objective of tempering is to

   (A) increase hardness
   (B) increase toughness and reduce brittleness
   (C) refine grain structure
   (D) enhance ductility

143. The primary function of a riser in casting is to

   (A) feed molten metal to compensate for shrinkage
   (B) trap impurities
   (C) act as a cooling channel
   (D) provide venting

144. The draft allowance in pattern design is provided to

   (A) account for shrinkage
   (B) provide material surplus
   (C) facilitate easy withdrawal of the pattern
   (D) compensate for distortion

145. Chills are used in casting to

   (A) slow down solidification
   (B) promote directional solidification
   (C) increase porosity
   (D) avoid turbulence

146. In directional solidification, the objective is to

    (A) increase cooling time

    (B) prevent internal voids and porosity

    (C) achieve uniform grain growth

    (D) reduce cost

147. Cold working of metals results in

    (A) reduced strength

    (B) lower dislocation density

    (C) increased ductility

    (D) strain hardening

148. In sheet metal operations, 'deep drawing' is used for

    (A) producing axisymmetric hollow parts

    (B) cutting sheets

    (C) edge finishing

    (D) flattening sheets

149. The von Mises yield criterion is based on

    (A) maximum normal stress

    (B) maximum shear stress

    (C) distortion energy theory

    (D) maximum principal strain

150. In hot working, the metal is deformed

    (A) above its recrystallization temperature

    (B) below its melting point

    (C) at room temperature

    (D) near 0 °C

151. In rolling, the neutral point is the location where

    (A) roll speed equals material speed

    (B) roll contact ends

    (C) shear force is maximum

    (D) friction is zero

152. In powder metallurgy, sintering involves

    (A) melting powder

    (B) bonding powder particles below melting point

    (C) quenching

    (D) rolling powders

153. Brazing differs from welding because

    (A) the base metal does not melt

    (B) it uses higher temperatures

    (C) it is done in vacuum

    (D) flux is not required

154. Broaching process is used for

    (A) drilling only

    (B) turning

    (C) producing keyways and splines

    (D) milling flats

155. The rake angle of a single-point cutting tool affects

    (A) feed rate

    (B) surface roughness

    (C) chip formation and cutting forces

    (D) cutting fluid effectiveness

156. In orthogonal cutting, the shear angle increases with

(A) decreasing rake angle

(B) decreasing friction angle

(C) increasing cutting speed

(D) increasing uncut chip thickness

157. In metal cutting, the specific cutting energy

(A) increases with uncut chip thickness

(B) decreases with increase in chip thickness

(C) remains constant

(D) is independent of material

158. In orthogonal cutting, if the rake angle increases, the cutting force

(A) decreases

(B) increases

(C) remains constant

(D) becomes negative

159. In non-traditional machining, electro-chemical machining is best for

(A) machining hard conductive materials without tool wear

(B) high precision ceramic machining

(C) cutting plastics

(D) machining wood

160. In non-traditional machining, EDM removes material by

(A) spark erosion

(B) mechanical abrasion

(C) high-pressure water

(D) magnetic fields

161. Tool life increases with

(A) increased cutting speed

(B) increased temperature

(C) proper coolant application

(D) increased feed

162. Alignment tests in machine tools ensure

(A) geometrical accuracy

(B) electrical conductivity

(C) hardness variation

(D) load capacity

163. CAM focuses on

(A) design

(B) manufacturing process automation

(C) forecasting

(D) warehousing

164. Additive manufacturing builds parts by

(A) subtracting material

(B) forging

(C) casting

(D) layer-by-layer deposition

165. In CNC, G-codes represent

(A) preparatory functions

(B) tool geometry

(C) error codes

(D) feedback

166. Integration of CAD and CAM provides

(A) redundant systems

(B) delayed feedback

(C) seamless data flow from design to production

(D) manual inputs

167. Aggregate production planning balances

(A) demand and production capacity

(B) sales and marketing

(C) inventory and deliveries

(D) raw material cost

168. The master production schedule is derived from

(A) maintenance schedule

(B) supplier availability

(C) forecasted demand

(D) equipment layout

169. Gantt charts are primarily used for

(A) demand estimation

(B) scheduling and tracking progress

(C) costing

(D) tool selection

170. Lean manufacturing aims to

(A) eliminate waste and improve flow

(B) increase WIP

(C) use more material

(D) slow down production

171. In EOQ model, total cost is minimum when

(A) holding cost is maximum

(B) ordering cost = holding cost

(C) stockout cost is minimized

(D) reorder point = demand

172. Safety stock is used to

(A) increase lead time

(B) avoid stockouts during fluctuations

(C) reduce cost

(D) increase WIP

173. ABC analysis is based on

(A) product weight

(B) storage area

(C) annual consumption value

(D) arrival time

174. In linear programming, constraints are always

(A) non-linear

(B) linear inequalities or equations

(C) exponential

(D) statistical

175. In PERT analysis, the expected time (T_E) is given by

(A) $(a+b)/2$

(B) $(a+b+m)/2$

(C) $(a+4m+b)/6$

(D) $(m+b)/2$

ELECTRICAL ENGINEERING

(*Marks* : 200)

Each question carries **2** marks

76. In a linear circuit, the superposition theorem is applicable only when

(A) the circuit contains resistors only

(B) the circuit contains dependent sources only

(C) the circuit contains linear elements and independent sources

(D) the circuit contains only inductors and capacitors

77. The Laplace transform of a capacitor C with initial voltage V_0 is

(A) $\dfrac{1}{Cs}$

(B) $\dfrac{1}{Cs} + V_0$

(C) $\dfrac{1}{Cs} + \dfrac{V_0}{s}$

(D) $\dfrac{1}{Cs} + CV_0$

78. For a series R-L-C circuit at resonance, the impedance is

(A) maximum

(B) minimum

(C) zero

(D) infinite

79. The quality factor Q of a series R-L-C circuit is given by

(A) $Q = \dfrac{1}{R}\sqrt{\dfrac{L}{C}}$

(B) $Q = R\sqrt{\dfrac{C}{L}}$

(C) $Q = \dfrac{R}{\omega L}$

(D) $Q = \omega RC$

80. A network is said to be reciprocal if

(A) it contains only independent sources

(B) input and output can be interchanged without changing the behavior

(C) all resistances are equal

(D) the network is time-invariant

81. In the Laplace domain, the transfer function $H(s) = \dfrac{V_{\text{out}}(s)}{V_{\text{in}}(s)}$ gives

(A) time-domain behavior

(B) frequency-domain response only at $s = j\omega$

(C) both transient and steady-state behavior

(D) steady-state behavior only

82. The convolution of two signals in time domain is equivalent to

(A) division in the Laplace domain

(B) multiplication in the Laplace domain

(C) addition in the Laplace domain

(D) differentiation in the Laplace domain

83. The state-space representation of a linear time-invariant circuit consists of

(A) a single first-order differential equation

(B) a set of non-linear algebraic equations

(C) a set of first-order differential equations

(D) Kirchhoff's laws only

84. The real part of a pole determines

(A) the frequency of oscillation

(B) the amplitude of input signal

(C) the exponential decay or growth rate

(D) the phase angle only

85. For a system to be causal, its output at any time t must depend on

(A) future inputs only

(B) past and present inputs only

(C) present and future inputs only

(D) entire input history including future

86. The transfer function of a unity feedback system is given by

$$G(s) = \frac{K}{s(s+3)(s+5)}$$

The type and order of the system are

(A) type–0, order–3

(B) type–1, order–3

(C) type–1, order–2

(D) type–2, order–3

87. The root locus of a control system is a plot of

(A) time response versus gain

(B) roots of the numerator of the transfer function

(C) locations of closed-loop poles as system gain varies

(D) magnitude versus frequency

88. The time constant of a first-order system is

(A) the time taken to reach half of the final value

(B) the inverse of the natural frequency

(C) the time taken for the system to reach 63·2% of its final value

(D) always 1 second

89. A transfer function has a zero at the origin. The system is

(A) type 0　　　(B) type 1

(C) type 2　　　(D) unstable

90. The characteristic equation of a control system determines

(A) steady-state error

(B) input-output relationship

(C) stability

(D) controllability

91. Which of the following compensators improves steady-state accuracy?

(A) Lead

(B) Lag

(C) Lead-lag

(D) Proportional

92. In a proportional-derivative (PD) controller

(A) only steady-state error is improved

(B) only transient response is improved

(C) both steady-state and transient responses are improved

(D) the system becomes unstable

93. In root locus, breakaway points occur where

(A) two branches meet on real axis

(B) root locus intersects imaginary axis

(C) zeros and poles coincide

(D) phase angle is 180°

94. The Routh-Hurwitz criterion fails when

(A) the first column becomes zero

(B) the system has imaginary poles

(C) all coefficients are negative

(D) degree of numerator exceeds degree of denominator

95. A system with transfer function $\dfrac{s+3}{s^2+2s+2}$ has

    (A) two real poles

    (B) a pole and a zero in right-half plane

    (C) complex conjugate poles and a left-half plane zero

    (D) right-half plane zero

96. In a DC generator, the generated EMF is directly proportional to

    (A) armature resistance

    (B) load current

    (C) speed and flux per pole

    (D) commutator segments

97. The torque in a DC motor is given by

    (A) $T = K\phi I_a$ (B) $T = KV^2$

    (C) $T = K\dfrac{I_a}{\phi}$ (D) $T = K\phi^2$

98. If the field winding of a DC shunt motor opens during operation, then the motor

    (A) stops immediately

    (B) runs at constant speed

    (C) accelerates to dangerously high speed

    (D) slows down gradually

99. The back EMF in a BLDC motor is

    (A) sinusoidal

    (B) constant

    (C) trapezoidal or rectangular

    (D) random

100. The no-load current in a transformer is

    (A) very high and purely resistive

    (B) high and lagging

    (C) low and highly inductive

    (D) equal to full-load current

101. In a transformer, core loss depends primarily on

    (A) load current

    (B) supply frequency and voltage

    (C) load power factor

    (D) transformer rating

102. The efficiency of an induction motor is maximum when

    (A) slip = 1

    (B) copper loss = core loss

    (C) rotor copper loss is maximum

    (D) stator current is minimum

103. A wound rotor induction motor allows control of

    (A) stator voltage

    (B) stator frequency

    (C) rotor resistance

    (D) magnetizing current

104. The excitation system of a synchronous generator is used to

    (A) adjust rotor speed

    (B) regulate terminal voltage

    (C) start the generator

    (D) control load

105. Hunting in synchronous machines refers to

(A) searching for maximum power

(B) speed oscillations about synchronous speed

(C) sudden loss of excitation

(D) overcurrent condition

106. The Biot-Savart law gives

(A) electric field due to a charge

(B) magnetic field due to a current element

(C) magnetic force on a moving charge

(D) divergence of electric field

107. The magnetic field inside an ideal long solenoid

(A) is zero

(B) is constant and along the axis

(C) varies inversely with radius

(D) is radial

108. In TEM wave propagation

(A) only electric field exists

(B) only magnetic field exists

(C) both $\vec{E}$ and $\vec{H}$ are transverse to direction of propagation

(D) $\vec{E}$ is parallel to $\vec{H}$

109. At the boundary of two dielectrics, the tangential component of the electric field

(A) must be continuous

(B) must be zero

(C) equals surface charge density

(D) is perpendicular to the surface

110. The normal component of magnetic flux density B at an interface is

(A) zero

(B) discontinuous

(C) continuous

(D) equal to surface current

111. Poynting vector $\vec{S}$ represents

(A) magnetic flux density

(B) electric field

(C) power flow per unit area

(D) energy stored in field

112. In a good conductor, the electromagnetic wave

(A) propagates without attenuation

(B) penetrates deeply

(C) is attenuated exponentially

(D) is reflected without loss

113. Skin depth δ in a conductor is given by

(A) $\delta = \sqrt{\dfrac{2}{\mu\sigma\omega}}$ (B) $\delta = \sqrt{\mu\varepsilon}$

(C) $\delta = \dfrac{1}{\sigma\varepsilon}$ (D) $\delta = \dfrac{1}{\omega\mu}$

114. At the interface between a conductor and free space, the normal component of $\vec{B}$

(A) is continuous

(B) is zero

(C) equals surface charge

(D) is undefined

115. In a lossy dielectric, the propagation constant γ is

(A) purely real

(B) purely imaginary

(C) complex

(D) zero

116. The load factor of a power plant is the ratio of

(A) maximum demand to connected load

(B) average load to maximum demand

(C) average load to connected load

(D) maximum demand to average load

117. Which of the following power plants has the lowest operating cost?

(A) Thermal

(B) Nuclear

(C) Hydroelectric

(D) Diesel

118. The efficiency of a modern thermal power plant is typically

(A) 25%–30%

(B) 40%–45%

(C) 50%–55%

(D) above 60%

119. A high-voltage transmission line typically operates at

(A) 11 kV

(B) 33 kV

(C) 132 kV or above

(D) 415 V

120. Ferranti effect is observed in

(A) long transmission lines under heavy load

(B) short transmission lines at no load

(C) long transmission lines at no load

(D) short transmission lines under heavy load

121. Reactive power in power systems primarily affects

(A) frequency

(B) voltage magnitude

(C) power factor

(D) energy meter reading

122. A symmetrical fault

(A) is most common

(B) is least severe

(C) is balanced in all phases

(D) involves ground only

123. Swing equation is used in power systems for

(A) fault current calculation

(B) relay setting

(C) stability analysis

(D) load flow

124. For a line-to-ground fault on an unloaded generator, the fault current is highest when the fault is

(A) far from generator

(B) near generator terminal

(C) near the load

(D) across transformer

125. The small signal stability of a power system is affected by

(A) lightning strikes

(B) generator excitation system

(C) transmission line resistance

(D) earth fault current

126. Which one of the following power semiconductor devices is a voltage-controlled device?

(A) SCR (B) GTO

(C) BJT (D) IGBT

127. A boost converter is used to step up 12 V to 48 V. If the duty cycle is 75%, then what is the efficiency assuming ideal components?

(A) 50% (B) 75%

(C) 100% (D) 90%

128. In a three-phase full converter feeding a resistive load, the output voltage waveform is

(A) pure DC

(B) pulsating DC with 120° intervals

(C) sinusoidal

(D) rectified sine wave with 60° intervals

129. What is the main function of the snubber circuit in power electronic devices?

(A) Reduce conduction losses

(B) Improve power factor

(C) Suppress voltage spikes and protect devices

(D) Boost output voltage

130. A single-phase fully controlled bridge rectifier feeds a highly inductive load. The output voltage becomes zero when

(A) input voltage is zero

(B) all SCRs are turned off

(C) the load current becomes zero

(D) the input voltage reverses polarity

131. In a single-quadrant chopper, the output voltage can be

(A) positive or negative

(B) only positive

(C) only negative

(D) positive or zero

132. In resonant converters, zero-voltage switching (ZVS) reduces

(A) conduction losses

(B) output ripple

(C) switching losses

(D) load current

133. In sinusoidal PWM (SPWM) inverter, the modulation index is defined as

(A) ratio of carrier frequency to modulating frequency

(B) ratio of amplitude of carrier to modulating signal

(C) ratio of amplitude of modulating signal to carrier signal

(D) ratio of output voltage to input voltage

134. In a voltage source inverter (VSI), the commutation is

(A) natural commutation

(B) forced commutation

(C) load commutation

(D) self-commutation

135. In a single-phase AC voltage controller with resistive load, the range of firing angle α is

(A) 0° to 90°

(B) 0° to 180°

(C) 0° to 360°

(D) 90° to 270°

136. The minimum number of flip-flops required to build a mod 30 counter is

(A) 4   (B) 5

(C) 6   (D) 7

137. A parity bit is used for

(A) increasing voltage levels

(B) error detection

(C) clock synchronization

(D) frequency modulation

138. What is the output of the expression $A + ABA + ABA + AB$?

(A) AB (B) A

(C) B (D) $A + B$

139. A full adder can be constructed using

(A) two half adders and one OR gate

(B) two half adders and one AND gate

(C) three half adders

(D) one half adder and one NAND gate

140. The race-around condition in a J-K flip-flop can be avoided by

(A) using edge triggering

(B) using level triggering

(C) connecting J and K to 0

(D) keeping clock signal high always

141. The output of a D flip-flop is always

(A) the inverse of input

(B) equal to input at rising edge of clock

(C) equal to input at falling edge of clock

(D) delayed by 2 clock cycles

142. In an 8-to-1 multiplexer, how many selection lines are required?

(A) 2   (B) 3

(C) 4   (D) 8

143. What is the primary advantage of using a Gray code in digital systems?

(A) It uses fewer bits

(B) It has more logic levels

(C) Only one bit changes between successive codes

(D) It is same as binary

144. Which flip-flop is commonly used for frequency division and counters?

(A) D flip-flop

(B) T flip-flop

(C) J-K flip-flop

(D) S-R flip-flop

145. A Schmitt trigger is used in digital circuits to

(A) act as a buffer

(B) eliminate power loss

(C) remove noise from signals and provide hysteresis

(D) increase logic levels

146. In a BJT differential amplifier, increasing the tail current source (I_{EE}) leads to

(A) decrease in differential gain

(B) increase in input impedance

(C) decrease in common-mode rejection ratio (CMRR)

(D) increase in differential gain

147. Which configuration provides the highest input impedance in a BJT amplifier?

(A) Common base

(B) Common collector (emitter follower)

(C) Common emitter

(D) Darlington pair

148. The dominant pole in an op-amp frequency response is primarily due to

(A) output stage inductance

(B) input offset voltage

(C) compensation capacitor

(D) slew rate

149. Which of the following improves the common-mode rejection ratio (CMRR) in a differential amplifier?

(A) Use of resistive tail

(B) Use of current mirror as active load

(C) Increasing emitter resistance

(D) Decreasing collector resistance

150. Thermal runaway in BJTs occurs because

(A) current gain increases with temperature

(B) collector current increases with temperature, causing more heating

(C) V_{BE} increases with temperature

(D) input resistance decreases

151. For a source follower (common-drain) MOSFET amplifier, the voltage gain is approximately

(A) greater than 1

(B) equal to 0

(C) slightly less than 1

(D) negative and large

152. A cascode amplifier configuration improves

(A) input impedance

(B) output impedance and bandwidth

(C) power dissipation

(D) DC bias stability

153. Which of the following is **not** a characteristic of negative feedback in amplifiers?

(A) Reduced gain

(B) Improved bandwidth

(C) Improved linearity

(D) Increased distortion

154. In a differential amplifier using MOSFETs, perfect matching ensures

(A) increased gain

(B) zero output

(C) zero common-mode gain

(D) increased offset voltage

155. In an emitter-follower BJT configuration, the voltage gain is approximately

(A) greater than 1

(B) negative and large

(C) unity

(D) zero

156. The 8085 microprocessor has how many address lines?

(A) 8   (B) 16

(C) 32   (D) 64

157. Which of the following flags is **not** present in the 8085 microprocessor?

(A) Zero   (B) Parity

(C) Overflow   (D) Sign

158. In 8051 microcontroller, the sizes of on-chip ROM and RAM respectively, are

(A) 2 KB and 128 bytes

(B) 4 KB and 128 bytes

(C) 4 KB and 256 bytes

(D) 8 KB and 128 bytes

159. What is the function of the 'DAA' instruction in 8085?

(A) Adjusts the accumulator after BCD addition

(B) Adds accumulator with carry

(C) Decimal addition with accumulator

(D) Subtracts with borrow

160. In 8051, which register is used to control timer operations?

(A) TMOD   (B) TCON

(C) PCON   (D) SCON

161. A causal system is one where

(A) output depends on future input

(B) output depends only on past and present input

(C) output depends on derivative

(D) output is zero for all t

162. A linear system satisfies the principle of

(A) time invariance

(B) superposition

(C) causality

(D) memory

163. According to the sampling theorem, a signal can be reconstructed if sampled at

(A) half the maximum frequency

(B) twice the maximum frequency

(C) same as maximum frequency

(D) any rate

164. Time scaling of a signal $x(at)$ in frequency domain results in

(A) stretching the spectrum

(B) compressing the spectrum

(C) amplitude modulation

(D) frequency shift

165. For a stable LTI system, the pole of the transfer function must lie
   (A) on the imaginary axis
   (B) inside the unit circle (discrete)/ left-half plane (continuous)
   (C) outside the unit circle/right-half plane
   (D) anywhere in the complex plane

166. A measurement system is said to be more accurate if it has
   (A) high error
   (B) high drift
   (C) low uncertainty
   (D) low resolution

167. The standard deviation in a set of readings represents
   (A) accuracy   (B) linearity
   (C) precision   (D) drift

168. LVDT is used to measure
   (A) pressure
   (B) displacement
   (C) current
   (D) temperature

169. A piezoelectric transducer is generally used to measure
   (A) displacement
   (B) voltage
   (C) force or acceleration
   (D) temperature

170. Kelvin's double bridge is used to measure
   (A) high resistance
   (B) low resistance
   (C) capacitance
   (D) inductance

171. Anderson's bridge is used to measure
   (A) mutual inductance
   (B) high voltage
   (C) self-inductance
   (D) capacitance

172. Which instrument is best suited for measuring true RMS of non-sinusoidal signals?
   (A) Moving-iron instrument
   (B) Thermocouple-type instrument
   (C) Digital voltmeter
   (D) Electrodynamometer

173. An instrumentation amplifier is preferred when
   (A) high current gain is required
   (B) high voltage gain with low noise is required
   (C) only AC signals are to be measured
   (D) output impedance needs to be high

174. In RMS value measurement using digital techniques, the input signal is
   (A) averaged directly
   (B) rectified and then squared
   (C) squared, averaged, and square-rooted
   (D) counted digitally

175. A CRO is primarily used to measure
   (A) average values
   (B) transient signals
   (C) RMS value
   (D) power factor