

ENTRANCE EXAMINATION FOR ADMISSION, MAY 2012.

Ph.D. (GREEN ENERGY TECHNOLOGY)

COURSE CODE : 159

Register Number :

\_\_\_\_\_  
*Signature of the Invigilator*  
(with date)

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COURSE CODE : 159

Time : 2 Hours

Max : 400 Marks

*Instructions to Candidates :*

1. Write your Register Number within the box provided on the top of this page and fill in the page 1 of the answer sheet using pen.
2. Do not write your name anywhere in this booklet or answer sheet. Violation of this entails disqualification.
3. Read each of the question carefully and shade the relevant answer (A) or (B) or (C) or (D) in the relevant box of the ANSWER SHEET using HB pencil.
4. Avoid blind guessing. A wrong answer will fetch you -1 mark and the correct answer will fetch 4 marks.
5. Do not write anything in the question paper. Use the white sheets attached at the end for rough works.
6. Do not open the question paper until the start signal is given.
7. Do not attempt to answer after stop signal is given. Any such attempt will disqualify your candidature.
8. On stop signal, keep the question paper and the answer sheet on your table and wait for the invigilator to collect them.
9. Use of Calculators, Tables, etc. are prohibited.

1. Optical fiber is the example for  
(A) Light reflector (B) Light absorber (C) Light generator (D) Wave guide
2. Moore's law describes the development in  
(A) Computer integration (B) Device integration  
(C) Community integration (D) Cloud computing
3. \_\_\_\_\_ is called as the heart beat of a computer  
(A) CPU (B) Software  
(C) Hardware (D) Clock frequency
4. \_\_\_\_\_ force of the wind maintain the altitude of the plane  
(A) Thrust (B) Drag (C) Lift (D) Acceleration
5. Lithography of materials is called as  
(A) Top down process (B) Scaling process  
(C) Bottom up process (D) Bottom scale process
6. The speed of sound propagation in the medium is  
(A) Amplitude dependent  
(B) Phase dependent  
(C) Frequency and wavelength dependent  
(D) Density and composition dependent
7. An alloy is the  
(A) Mixture of crystals (B) Complete mixture of solids  
(C) Mixture of metals (D) Complete mixture of dielectrics
8. Dopant is the foreign atom that contribute \_\_\_\_\_ upon inclusion into crystals  
(A) Neutrons (B) Charge carriers  
(C) Electricity (D) Magnetic field
9. Quantum confinement of particles results in the  
(A) Transport of particle (B) Pauli exclusion principle  
(C) Dual nature of motion (D) Acceleration to particle
10. Adsorptions are  
(A) 3 types (B) 2 types (C) 6 types (D) 4 types

11. The wave pattern generated in the laser cavity is called as
 

|                      |                   |
|----------------------|-------------------|
| (A) Standing wave    | (B) Wave selector |
| (C) Wave transmitter | (D) Wave guide    |
  
12. Refractive index is the measure of
 

|                                  |                                |
|----------------------------------|--------------------------------|
| (A) Speed of electrons in medium | (B) Speed of holes in medium   |
| (C) Speed of light in medium     | (D) Speed of phonons in medium |
  
13. The exchange of electrons during bonding in solid takes place in the
 

|                      |                           |
|----------------------|---------------------------|
| (A) Ionic bonding    | (B) Hydrogen bonding      |
| (C) Covalent bonding | (D) Van der wales bonding |
  
14. Bonding mechanism of DNA is
 

|                    |                          |
|--------------------|--------------------------|
| (A) Ionic bonding  | (B) Vander wales bonding |
| (C) Dipole bonding | (D) Hydrogen bonding     |
  
15. Interstitial atoms in the crystalline network is positioned at
 

|                         |                          |
|-------------------------|--------------------------|
| (A) Lattice sites       | (B) In between the atoms |
| (C) Above the positions | (D) Out of the positions |
  
16. The difference in the lattice constant of epitaxial layers result in
 

|                                |                               |
|--------------------------------|-------------------------------|
| (A) Strain at the interface    | (B) Relax at the interface    |
| (C) Oxidation at the interface | (D) Alloying at the interface |
  
17. The state of inter diffusion of materials is defined by
 

|                 |                |                 |                  |
|-----------------|----------------|-----------------|------------------|
| (A) Cooke's law | (B) Fick's law | (C) Charles law | (D) Fiemen's law |
|-----------------|----------------|-----------------|------------------|
  
18. Optical absorption coefficient is materials
 

|                            |                         |
|----------------------------|-------------------------|
| (A) Conductivity dependent | (B) Thickness dependent |
| (C) Temperature dependent  | (D) Viscosity dependent |
  
19. \_\_\_\_\_ energy of solar spectrum is converted into electrical energy
 

|                 |                       |
|-----------------|-----------------------|
| (A) Heat energy | (B) Photon energy     |
| (C) IR energy   | (D) UV-visible energy |
  
20. The brain of a computer is its
 

|                      |                          |
|----------------------|--------------------------|
| (A) Windows software | (B) Driver software      |
| (C) Windows office   | (D) Application software |

21. Let  $A$  be the matrix of order  $m \times n$ , then determinant of  $A$  exist if  
 (A)  $m > n$  (B)  $m < n$  (C)  $m \neq n$  (D)  $m = n$
22. The arithmetic mean of 3, 5, 7 and  $y$  is 100. What is the value of  $y$   
 (A) 85 (B) 385 (C) 285 (D) 485
23.  $\lim_{x \rightarrow 0} \frac{e^x - 1}{x}$  is equal to  
 (A)  $-1$  (B)  $0$  (C)  $1$  (D)  $i$
24. From the following type of matrix, the diagonal element of which matrix must be pure imaginary number or zero  
 (A) Skew - Hermitian (B) Symmetric  
 (C) Hermitian (D) Skew Symmetric
25. For XOR operator  $\oplus$  which one is not correct  
 (A)  $1 \oplus 1 = 0$  (B)  $1 \oplus 0 = 1$   
 (C)  $0 \oplus 1 = 1$  (D)  $0 \oplus 0 = 1$
26. When two vectors  $A(i)$  and  $B(j)$  are orthonormal then  
 (A)  $A(i) \cdot B(j) = 0$  (B)  $A(i) \cdot B(j) = 1$   
 (C)  $A(i) \cdot B(j) = \delta_{ij}$  (D)  $A(i) \cdot B(j) = \infty$
27. Consider a function  $f(x) = \begin{cases} x^2 & x \text{ is rational} \\ -x^2 & x \text{ is irrational then} \\ \text{undefined} & x = 0 \end{cases}$   
 (A)  $\lim_{x \rightarrow a} f(x)$  exist for infinitely many 'a'  
 (B) There is no  $a$  for which  $\lim_{x \rightarrow a} f(x)$  exist  
 (C) There may be some 'a' for which  $\lim_{x \rightarrow a} f(x)$  exists, but it is impossible to say without more information  
 (D)  $\lim_{x \rightarrow a} f(x)$  exists only when  $a = 0$
28. The price of sugar is increased by 20%. As a result, a family decreases its consumption by 25%. The expenditure of the family on sugar will be decreased by  
 (A) 10% (B) 5% (C) 14% (D) 15%

29. One number is to be randomly selected from the set  $\{1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12\}$  what is the probability of selecting a number that is odd or is a multiple of 3
- (A)  $\frac{1}{3}$                       (B)  $\frac{1}{2}$                       (C)  $\frac{2}{3}$                       (D)  $\frac{5}{6}$
30. Which of the following is the reflection of the point  $\left(\frac{3}{5}, \frac{4}{5}\right)$  through the line  $y = -x$  in the  $xy$  plane
- (A)  $\left(\frac{3}{5}, \frac{-4}{5}\right)$               (B)  $\left(\frac{-3}{5}, \frac{4}{5}\right)$               (C)  $\left(\frac{4}{5}, \frac{3}{5}\right)$               (D)  $\left(\frac{-4}{5}, \frac{-3}{5}\right)$
31. Two numbers are respectively 20% and 50% more than a third number. The ratio of the two numbers is
- (A) 2 : 5                      (B) 3 : 5                      (C) 4 : 5                      (D) 6 : 7
32. The period of  $|\sin(3x)|$  is
- (A)  $2\pi$                       (B)  $2\frac{\pi}{3}$                       (C)  $\frac{\pi}{3}$                       (D)  $3\pi$
33. A school committee consists of 2 teachers and 4 students. The number of different committees that can be formed from 5 teachers and 10 students is
- (A) 10                      (B) 5                      (C) 2100                      (D) 15
34. The graphs of the two linear equations  $ax + by = c$  and  $bx - ay = c$  where  $a, b, c$  are all not equal to zero
- (A) Parallel                      (B) Perpendicular  
(C) Intersect at two points              (D) Neither parallel nor perpendicular
35. The next number in the sequence 3, 6, 11, 18, 27 is
- (A) 34                      (B) 36                      (C) 38                      (D) 40
36. If  $f: x \rightarrow 3x^2 - 1$  then  $f(2)$  is
- (A) 3                      (B) 9                      (C) 11                      (D) 13
37. A circle has equation  $x^2 + y^2 + 4x - 2y - 4 = 0$  which of the following correctly states the coordinates of the center and the value of the radius
- (A)  $(-2, -1), r = 3$               (B)  $(2, -1), r = 3$               (C)  $(-2, 1), r = 1$               (D)  $(2, -1), r = 1$
38. A sequence is defined by the recurrence relation  $u_{n+1} = pu_n + q$ , which of the following would be an expression for  $u_2$
- (A)  $u_2 = 3p + q$                       (B)  $u_2 = 3p^2 + pq + q$   
(C)  $u_2 = 6p + 2q$                       (D)  $u_2 = 9p^2 + 6pq + q^2$

39. What is the value of  $\int_{-1}^2 x^3 dx$
- (A)  $\frac{15}{4}$  (B) 15 (C) 4 (D)  $\frac{17}{4}$
40. The real number  $x$  when added to its inverse gives the minimum value of the sum. Then  $x$  is equal to
- (A) 1 (B) 2 (C)  $i$  (D)  $1 - i$
41. DNA sequences needed for division of eukaryotic chromatids during mitosis is
- (A) Telomere (B) Centromere (C) Centrosome (D) Kinetochores
42. The mechanism of action of hormone is
- (A) Binding to membrane receptor and activation the secondary messengers  
 (B) Binding to cytosolic receptor and hormone receptor complex and activation target gene expression  
 (C) Moves to nucleus and start transcription  
 (D) Hormone effects mainly protein synthesis
43. Red blood cells are formed in
- (A) Liver (B) Bone marrow (C) Lymph node (D) Lungs
44. EDTA is used as oxidizing agent
- (A) Oxidizing agent (B) Reducing agent  
 (C) Chelating agent (D) Buffering agent
45. Uricotelism is found in
- (A) Mammals and birds (B) Fishes and fish-water protozoans  
 (C) Birds, reptiles and insects (D) Frogs and toads
46. Super antigen can stimulate
- (A) Only T cells by binding to TCR in the absence of antigen presenting cells  
 (B) T and B and any other type of cells  
 (C) Only T cells by binding to  $V\beta$  domain of T cells receptors, an MHC-II molecule, an antigen presenting cell  
 (D) Only T cells by binding to CD2 molecules
47. Biomass turn-over time is the ratio between biomass and productivity of ecosystem. Which of the following forest should have highest biomass turn-over time?
- (A) Tropical dry forest (B) Tropical wet forest  
 (C) Temperate deciduous forest (D) Boreal forest
48. Replication of DNA is carried out by
- (A) DNA polymerase (B) RNA polymerase  
 (C) DNA Ligase (D) Actin filament

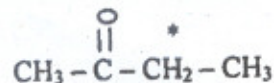
49. Distribution of enzyme in micro bodies help in effective
- (A) Translation (B) Replication  
(C) Photosynthesis (D) Metabolism
50. Region in which DNA is wrapped tightly around a cluster of histone protein is called
- (A) Chromatin (B) Chromosome  
(C) Nucleosome (D) Nucleoid
51. Autoerine signaling involves
- (A) Expression of receptors that bind to its own plasma membrane  
(B) Excretion of receptors that binds to neighboring cells  
(C) Exocytosis of receptors to neighboring cells of same kind  
(D) Internalization of proteins through endocytosis
52. Which of the following is an inhibitory neurotransmitter?
- (A) Acetylcholine (B) Acetylcholine esterase  
(C) Glutamate (D) Glycine
53. Sleeping sickness is caused by
- (A) *Entamoeba histolytica* (B) *Trichomonas vaginalis*  
(C) *Trypanosoma brucei* (D) *Saccharomyces cerevisiae*
54. In DNA analysis if Adenosine constitute 25% and Guanine constitute 16% of all nucleotides then it must be
- (A) Single stranded DNA  
(B) Double stranded DNA  
(C) Very short stretch double stranded DNA  
(D) Multi-chromosomal DNA
55. Photosynthesis in water bodies is restricted to certain depth. This is because
- (A) Temperature decrease with depth  
(B) Light intensity decrease with depth  
(C) Dissolved  $\text{CO}_2$  is available only to a certain depth  
(D) Nutrient are available only to a certain depth
56. Organism that directly uses  $\text{CO}_2$  as their sole source of carbon are termed as
- (A) Autotrophs (B) Heterotrophs  
(C) Auxotrophs (D) Chemotrophs

57. When an inorganic molecule other than oxygen accepts hydrogen, the process can be classified as  
 (A) Aerobic respiration (B) Anaerobic respiration  
 (C) Fermentation (D) Catalysis
58. Difference in host response between individuals for same infection is nicely exemplified in the case of  
 (A) Leishmaniasis (B) Plasmodium falciparum  
 (C) S. Japonicum (D) Staphylococcus aureus
59. Proteins whose binding to DNA acts to present transcription are known as  
 (A) Operators (B) Activators (C) Repressor (D) Enhancer
60. The chemical basis of gene imprinting is  
 (A) Phosphorylation of DNA (B) Oxidation of DNA  
 (C) Glycosylation of DNA (D) Methylation of DNA
61. Which of the following oxides is amphoteric in character?  
 (A)  $CaO$  (B)  $CO_2$  (C)  $SiO_2$  (D)  $SnO_2$
62. When anhydrous hydrogen fluoride is dissolved in glacial acetic acid  
 (A)  $HF$  remains unionized  
 (B)  $H_2F^+$  and  $CH_3COO^-$  are formed  
 (C)  $F^-$  and  $CH_3COOH_2^+$  are formed  
 (D) Acetic anhydride is formed
63. Consider the coordination compound,  $Na_2[Pt(CN)_4]$ . The Lewis acid is  
 (A)  $Na^+$  (B)  $Pt$  (C)  $Pt^{2+}$  (D)  $CN^-$
64. The reagent commonly used to determine hardness of water titrimetrically is  
 (A) Oxalic acid (B) Disodium salt  $O^+$  EDTA  
 (C) Sodium citrate (D) Sodium thio-sulphate
65. In  $Fe(CO)_5$  the  $Fe-C$  bond possesses  
 (A) p-character only (B) both s and p characters  
 (C) ionic character (D) s-character only



66. The shape of  $\text{XeO}_4$  is  
 (A) Octahedral (B) Pyramidal  
 (C) Square pyramid (D) Tetrahedral
67. Identify the species with atom in +6 oxidation state for the following  
 (A)  $\text{MnO}_4^-$  (B)  $\text{Cr}(\text{CN})_6^{3-}$   
 (C)  $\text{CrO}_2\text{Cl}_2$  (D)  $\text{NiF}_6^{2-}$
68. Which element has the highest ionization energy?  
 (A) Mg (B) Ca (C) Sr (D) Ba
69. The point group symmetry of  $\text{BrF}_5$  is  
 (A)  $D_{3h}$  (B)  $C_{4v}$  (C)  $D_{4v}$  (D)  $C_{3v}$
70. A sudden jump between second and third ionization energies of an atom would be associated with the electronic configuration  
 (A)  $1s^2 2s^2 2p^6$  (B)  $1s^2 2s^2 2p^6 3s^2$   
 (C)  $1s^2 2s^2 2p^6 3s^2 3p^1$  (D)  $1s^2 2s^2 2p^6 3s^2 3p^2$
71. When hydrogen nuclei trap neutrons, they form  
 (A) Tritium (B) Deuterium (C) Beta rays (D) Positron
72. Which one of the following species has same bond order?  
 (A)  $\text{CN}^+$  and  $\text{CN}^-$  (B)  $\text{O}_2^-$  and  $\text{CN}^-$   
 (C)  $\text{NO}^+$  and  $\text{CN}^-$  (D)  $\text{NO}^+$  and  $\text{CN}^+$
73. The carbide which gives propyne upon hydrolysis is  
 (A)  $\text{Be}_2\text{C}$  (B)  $\text{Mg}_2\text{C}$  (C)  $\text{CaC}$  (D)  $\text{SiC}$
74. In the hydrogenation of oils, the catalysts used is  
 (A) Nickel (B) Iron (C) Platinum (D) Molybdenum
75. The pyrimidine base present in DNA are  
 (A) Cytosine and Adenine (B) Cytosine and Guanine  
 (C) Cytosine and Thymine (D) Cytosine and Uracil
76. The kinetic energy of particles of an ideal gas is a measure of  
 (A) Density (B) Viscosity (C) Temperature (D) Refractive

77. In Joule — Thomson expansion.
- (A)  $d_S = 0$                       (B)  $d_H = 0$                       (C)  $d_E = 0$                       (D)  $d_G = 0$
78. Which of the following forms a positively charged sol?
- (A)  $Fe(OH)_2$                       (B)  $As_2S_3$                       (C)  $Au$                       (D) Starch
79. How many EDTA (ethylene diamine tetraacetic acid) molecules are required to make an octahedral complex with a  $Ca^{2+}$  ion?
- (A) Six                      (B) Three                      (C) One                      (D) Two
80. What is the multiplicity expected in the proton NMR spectrum for the hydrogen atoms marked a 'star' in following compound?



- (A) Quartet                      (B) Triplet                      (C) Doublet                      (D) Singlet
81. Which one of the following is reduced by using stock bridge dampers on power overhead transmission lines?
- (A) Sag                      (B) Conductor vibration  
(C) Line losses                      (D) Mechanical tension
82. What is buoyant force?
- (A) Lateral force acting on a submerged body  
(B) Resultant force acting on a submerged body  
(C) Resultant force due to water on a body  
(D) Resultant hydrostatic force on a body due to fluid surrounding it
83. A tachometer is added to a servomechanism because
- (A) It is easily adjustable  
(B) It can adjust damping  
(C) It converts velocity of the shaft to a proportional d.c. voltage  
(D) It reduces steady-state error
84. In a simple impulse turbine the nozzle angle at the entrance is  $30^\circ$ . For maximum diagram efficiency what is the blade — speed ratio?
- (Note:  $\sin 30^\circ = 0.5$ ,  $\cos 30^\circ = 0.866$ ,  $\sin 15^\circ = 0.259$ ,  $\cos 15^\circ = 0.966$ )
- (A) 0.259                      (B) 0.75                      (C) 0.5                      (D) 0.433

85. How can the power supplied to a frequency heating system be measured?  
 (A) By dynamometer watt meter  
 (B) By induction wattmeter  
 (C) By thermocouple type wattmeter  
 (D) By moving iron ammeter and volt meter
86. If the enthalpy drop in the moving blades and fixed blades of a steam turbine is 10 KJ/Kg and 15 KJ/Kg respectively then what is the degree of reaction?  
 (A) 67% (B) 60% (C) 40% (D) 33%
87. Which one of the following is not the criterion used to select a potentiometer in a control system?  
 (A) Accuracy (B) Noise (C) Time response (D) Frequency
88. In a reversible isothermal process, the fluid expands from 10 bar and 2 m<sup>3</sup> to 2 bar and 10 m<sup>3</sup>. During the process the heat supplied is 100KW. What is the workdone during the process?  
 (A) 33.3 KW (B) 100 KW (C) 80 KW (D) 20 KW
89. For elimination of 5<sup>th</sup> harmonics from the output of an inverter, what will be the position of pulse in a PWM inverter?  
 (A) 70° (B) 36° (C) 60° (D) 90°
90. The strain gauge with a resistance of 250 ohm undergoes a change of 0.15 ohm. During a test the strain is  $1.5 \times 10^{-4}$ . What is the gauge factor?  
 (A) 4.7 (B) 4.0 (C) 3.5 (D) 2.0
91. In which one of the following processes, in a closed system the thermal energy transferred to a gas is completely converted to internal energy resulting in an increase in gas temperature?  
 (A) Isochoric process (B) Adiabatic process  
 (C) Isothermal process (D) Free Expansion
92. Complete combustion of pulverized coal in a steam raising thermal power plant is ensured by what type of an analysis of flue gas going out by the chimney?  
 (A) O<sub>2</sub> content for given air intake (B) CO<sub>2</sub> content for given fuel rate feed  
 (C) CO content (D) All the above

93. Which one of the following set of materials is most commonly used in catalytic converters for CI engines?
- (A) Platinum, palladium and rhodium  
 (B) Palladium, rhodium and ruthenium  
 (C) Rhodium, ruthenium and platinum  
 (D) Ruthenium, platinum and palladium
94. Magnetically hard materials do not possess which of the following characteristics?
- (A) High retentivity (B) High coercivity  
 (C) Strong magnetic reluctance (D) Zero differential permeability
95. Which one of the following parameters is significant to ascertain chemical equilibrium of a system?
- (A) Clapeyron relation (B) Maxwell relation  
 (C) Gibbs function (D) Helmholtz function
96. Quartz and  $BaTiO_3$  exhibit which of the following properties
- (A) Magnetostriction (B) Ferromagnetism  
 (C) Piezoelectricity (D) Ferroelectricity
97. For which one of the following materials, is the Hall coefficient zero?
- (A) Insulator (B) Intrinsic semiconductor  
 (C) Metal (D) Non-metal
98. A reversible heat engine rejects 50 percent of the heat supplied during a cycle of operation. If the engine is reversed and operates as a heat pump, then what is its coefficient of performance?
- (A) 1.0 (B) 1.5 (C) 2.0 (D) 2.5
99. Which one of the following symptoms shows that the combustion is necessarily complete?
- (A) Presence of free carbon in exhaust (B) Presence of CO in exhaust  
 (C) Presence of oxygen in exhaust (D) Presence of nitrogen in exhaust
100. The power input to a 415V, 50HZ, 6 pole, 3 phase induction motor running at 975 rpm is 40KW. The stator losses are 1 KW and friction and windage losses total 2KW. What is the efficiency of the motor?
- (A) 92.5% (B) 92% (C) 90% (D) 88%