ACE
Engineering Academy

Hyderabad | Delhi | Bhopal |Pune | Bhubaneswar | Bengaluru |Lucknow | Patna | Chennai | Vijayawada | Visakhapatnam | Tirupati | Kukatpally| Kolkata

H.O: 204, II Floor, Rahman Plaza, Opp. Methodist School, Abids, Hyderabad-500001,

Ph: 040-23234418, 040-23234419, 040-23234420, 040 - 24750437

ESE- 2018 (Prelims) - Offline Test Series   Test-2

GENERAL STUDIES

SUBJECT: BASICS OF MATERIAL SCIENCE & ENGINEERING SOLUTIONS

01.   Ans: (c)
Sol: For FCC structure

$$4R = \sqrt{2}\,a$$

$$a = \frac{4R}{\sqrt{2}}$$

Volume of unit cell $= a^3$

$$= \left(\frac{4R}{\sqrt{2}}\right)^3 = \frac{64R^3}{2\sqrt{2}} = 16\sqrt{2}R^3$$

02.   Ans: (b)

03.   Ans: (c)
Sol: Properties of ferromagnetic domains:
1. Permanent magnetization
2. Each domain is magnetically saturated
3. Above Curie temperature domains disrupt

04.   Ans: (d)
Sol: For BCC structure

$$4R = \sqrt{3}a$$

Shortest distance between two atoms = 2R

(or) $\dfrac{\sqrt{3}a}{2}$

05.   Ans: (b)
Sol: Copper is an FCC structure material. In FCC units 4 atoms are situated.

06.   Ans: (c)
Sol: Dielectric constant of insulators depends on frequency and ambient temperature.

07.   Ans: (a)
Sol: Franz Lorentz law states that ratio of thermal conductivity to electrical conductivity is directly proportional to temperature

$$\frac{K}{\sigma} \propto T$$

08.   Ans: (b)

09.   Ans: (a)

10.   Ans: (c)
Sol: $\chi_e = \dfrac{C}{T}$

$$\frac{\chi_1}{\chi_2} = \frac{T_2}{T_1}$$

$$\frac{2 \times 10^{-5}}{\chi_2} = \frac{400}{300}$$

$$\chi_2 = 1.5 \times 10^{-5}$$

11.   Ans: (b)

12.   Ans: (b)

13. **Ans: (c)**

Sol: $(\chi_e)_{dia}$ = small & negative

$(\chi_e)_{para}$ = small & positive

$(\chi_e)_{ferro}$ = large & positive

14. **Ans: (a)**

Sol: M = 2.8 A/m,

$\chi_m = 0.0025 \Rightarrow 2.5 \times 10^{-3}$

$M = \chi_m H$

$2.8 = H \times 2.5 \times 10^{-3}$

$H = \dfrac{2.8}{2.5 \times 10^{-3}}$

$H = 11.20 \times 10^2$ A/m

Magnetic flux density $(\overline{B}) = \mu_0 (\overline{M} + H)$

$\mu_0 = 4\pi \times 10^{-7}$

$= 4\pi \times 10^{-7} (2.8 + 11.20 \times 10^2)$

$= 1.41 \times 10^{-3}$ Wb/m^2

15. **Ans: (b)**

16. **Ans: (c)**

Sol: $(\chi)_{super\ conducter} = -1$

Relative permeability $(\mu_R) = 1 + \chi$

$\mu_R = 0$

17. **Ans: (a)**   **18.** **Ans: (b)**

19. **Ans: (d)**

Sol: Quartz is a piezo electric material but not ferro electric material.

20. **Ans: (a)**

Sol: Inconel is an alloy of Ni, Cr, Fe, Mo. This material used in gas turbine blades.

21. **Ans: (b)**

Sol: Babbitt metal is an alloy of Sn and Cu. This material used in bearings.

22.   Ans: (c)

23.   Ans: (b)
Sol: % Carbon in steel is 0.01 to 2.1

24.   Ans: (b)

25.   Ans: (a)
Sol: In quantum well material one dimension in nano range and two dimensions are in nano range.

26.   Ans: (d)   **27.   Ans: (b)**

28.   Ans: (c)
Sol: Physical mixing of more than two materials is called as composite that may not be required in similar phases. Composite is a combination of matrix and reinforcement where thermostets are used preferably due to their high strength.

29.   Ans: (a)
Sol: Iron is a ferromagnetic material. Iron above curie's wiess temperature (723°C) behaves paramagnetic material. The paramagnetic material susceptibility is small and positive.

30.   Ans: (c)

31.   Ans: (b)
Sol: α-Iron 768°C to 910°C in non magnetic material.

32.   Ans: (a)
Sol: In a transformer, the core should have low coercivity and retentivity. Because high hysteresis loop area implies high hysteresis loss. Hence soft magnetic materials are used in the transformer core. In a transformer, the core should have high permeability to produce high magnetic flux density.

33.   Ans: (d)

34. **Ans: (a)**

35. **Ans: (b)**
Sol: The line defects are edge dislocations & screw dislocation.

36. **Ans: (d)**
Sol: Plane intercepts $= X \rightarrow \infty$
$$Y \rightarrow \frac{-1}{2}$$
$$Z \rightarrow \infty$$
$$\left(\infty, -\frac{1}{2}, \infty\right)$$
$$MI = \left(0, \bar{2}, 0\right) = \left(0\bar{2}0\right)$$

37. **Ans: (b)**
Sol: Hall petch equation
$$\sigma = \sigma_o + \frac{K}{\sqrt{d}}$$
σ = strength of material
d = grain size

38. **Ans: (a)**
Sol: Creep is a time dependent strain at constant load.

39. **Ans: (d)**

40. **Ans: (b)**

41. **Ans: (b)**
Sol: Composite materials are combination of more than one material.

42. **Ans: (d)**
Sol: All road, water, air transportation vehicles are made up of sandwich composites.

43. **Ans: (c)**

44. **Ans: (a)**

45. **Ans: (d)**

Sol: The electrical resistivity of a material increases with increase in alloy content because of increase in lattice vibrations.

46. **Ans: (a)**

Sol: Soft magnetic materials are easily magnetized and decreagnetized with small applied magnetic field.

47. **Ans: (a)**

Sol: Entropy and thermal conductivity decreases with decreasing temperature.

48. **Ans: (c)**

Sol: Carbon atoms occupies at internstitial with increase position of Iron and it forms an interstitial solid solution.

49. **Ans: (d)**

Sol: Fine grain materials are having large grain boundaries and they are low energy regions so external oxygen atoms easily react with grain boundary atoms forms rust.

Fine grain materials are not used in high temperature application purpose because they are having more slip deformation.

50. **Ans: (a)**

Sol: In semiconductors, the energy gap is 1 eV. At absolute zero temperature electrons are not having sufficient energy so they are not move into conduction band. Hence semiconductors are insulators at 0 k.

GATE TOPPERS

GATE 2017

Rank	Branch	Name
1	EC	PRAMOD
1	ME	SUDHEER
1	ME	HASAN ASIF
1	EE	SHIVAM SINGH
1	CE	MRIDUL RAKESH
1	CS	DEVAL N PATEL
1	IN	NAVEEN
2	EC	SREE KALYANI
2	CE	PUNEET KHANNA
2	IN	RAHUL MAHATO
2	IN	SHUBHAM BANSAL
2	PI	GAURAV DHAUDIYAL
3	EC	KARUN
3	EE	RAVI TEJA
3	ME	PRADIP BOBADE
3	CS	RAVI SHANKAR
3	CE	ANKUR TRIPATHI
4	EC	SONU SHARMA
4	EE	SARFRAJ NAWAZ
4	CE	CHIRAG MITTAL
4	ME	GAUSH ALAM
4	IN	MONTI
4	PI	Sanghamitra Adhikari
5	IN	VRAJESH SHAH
5	PI	ANKIT TIWARI
6	EC	LIKHITA SAI UPPU
6	CS	MEGHASHAYAM
6	EE	RAJASEKHAR REDDY
6	IN	RAMESH KAMULLA
6	PI	PINAL KUMAR RANA
7	IN	PANKAJ MISHRA
8	ME	DIVYANSHU JHA
8	PI	Mona Bhargava
9	EC	Anand Uppada
9	CS	Nihar Ranjan Sahoo
9	ME	DHRUV KUMAR JHA
10	EC	AMIT RAWAT
10	ME	ANKAN GUPTA
10	EE	SURAJ DASH
10	IN	PRAMOD MUDGAL
10	IN	NIRMAL SAHORKAR

ESE TOPPERS

ESE 2017

🏆 CE 🏆

Rank	Branch	Name
1	CE	NAMIT JAIN
2	CE	PRAVIND SINGH
3	CE	ANKIT
6	CE	RISHABH DANGAYACH
8	CE	ADITYA SINGH
9	CE	HIMANSHU GAUTAM
10	CE	AYUSH DUBEY

7 IN TOP 10 RANKS

🏆 **7** — All India 1st Rank in ESE.

🏆 E&T 🏆

Rank	Branch	Name
2	E&T	SUDHANSHU CHAUDHARY
3	E&T	KAVULURI SRINIVASULU
5	E&T	AMIT GAUTAM
6	E&T	SUBHRANGINI MISHRA
7	E&T	DEVADURGAM PAVAN KUMAR
8	E&T	DEEPALI GOYAL
9	E&T	ABHISHEK PRATAP SINGH
10	E&T	UMESH

8 IN TOP 10 RANKS

and many more...

🏆 EE 🏆

Rank	Branch	Name
2	EE	PREETI KUMARI
3	EE	SUMAN CHANDRA SHEKH
4	EE	HARSHIT KUMAR SINGH
5	EE	NIKHIL KUMAR
6	EE	DUSHYANT SINGH
8	EE	APOORVA GUPTA
9	EE	KIRAN BABU KONERU

7 IN TOP 10 RANKS

🏆 ME 🏆

Rank	Branch	Name
3	ME	SAURABH
4	ME	AMIT KUMAR RAI
6	ME	ANKAN GUPTA
7	ME	DHRUW JHA
9	ME	ADHARAJ GUPTA

5 IN TOP 10 RANKS

🏆 **27** — Ranks in Top 10 in ESE-2017

ACE
Engineering Academy
Leading Institute for ESE/GATE/PSUs
Since 1995

204, Rahman Plaza, Abids, Hyderabad Ph : 040-23234418/19/20