

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination (Regular/Backlog), April-May 2015

B. Tech in Electronics and Communication Engineering, Semester IV

Roll No.....

ECE 404/405 : ENGINEERING MATERIALS AND PROCESSES

Time: 3 hours

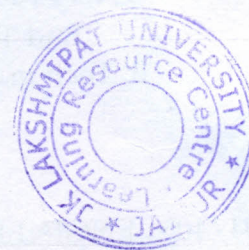
Max. Marks: 100

Instructions to students:

1. Do not write anything other than your roll number on question paper.
2. Assume suitable data wherever required and mention it clearly.
3. Writing appropriate units, nomenclature, and drawing neat sketches/schematics/ flow chart wherever, required are an integral part of the answer.

Q.1A Objective type multiple choice questions (10 questions @ 1 mark) 10

- i. Materials which can store electrical energy are called (a) magnetic materials (b) semiconductors (c) dielectric materials (d) super conductors.
- ii. Air is a non-dielectric material. (True / False)
- iii. The average dipole moment $\mathbf{p}$ of an elementary particle is assumed to be proportional to electric field strength $\mathbf{E}$, that acts on the particle so that $\mathbf{p} = \alpha \mathbf{E}$. What is α ? (a) reliability (b) permittivity (c) polarizability (d) homogeneity.
- iv. The critical temperature above which the ferromagnetic materials loose their magnetic property is known as (a) hysteresis (b) Curie point (c) transition temperature (d) standard temperature.
- v. Polarization in a dielectric on application of electric field is (a) Displacement/separation of opposite charge centres (b) Passing of current through dielectric (c) Breaking of insulation (d) Excitation of electrons to higher energy level.
- vi. With increase in temperature, the orientation polarization in general (a) decreases (b) increases (c) remains same (d) none of these.
- vii. The property due to which the resistance of some metal or compound vanishes under certain conditions is (a) Semi conductivity (b) Super conductivity (c) Curie point (d) Magnetostriction.
- viii. The non-degenerate semiconductors are doped to such high levels that the dopant atoms become an appreciable fraction of the host atoms. (True / False)
- ix. An electron passes through a magnetic field without being deflected. What can you say about the angle between the magnetic field vector and the electron's velocity, if no other forces are present? (a) They could be in the same direction (b) They could be perpendicular (c) They could be in opposite directions (d) Both the first and third are possible .
- x. What should happen to the length of a spring if a large current passes through it? Hint: Think about the current in neighboring spring coils. (a) It shortens (b) It lengthens (c) It expands (d) None of these.



Q.2	Short answer type questions (4 questions @ 2.5 marks) Compare the following by giving at least two points for each:	10
i.	Permittivity and Permeability	
ii.	Polarization and Magnetization	
iii.	Soft and Hard magnetic materials	
iv.	Eddy Current Loss and Hysteresis Loss	
Q.3A	The figure shows a parallel-plate capacitor of plate area A and plate separation $2d$. The left half of the gap is filled with material of dielectric constant $\kappa_1 = 12$; the top of the right half is filled with material of dielectric constant $\kappa_2 = 20$; the bottom of the right half is filled with material of dielectric constant $\kappa_3 = 30$. What is the capacitance in terms of ϵ_0 , A , and d ?	05
Q.3B	A wire carries a current of 7 A along the x axis and another wire carries a current of 6 A along the y axis as shown in the figure. What is the magnetic field at point P located at $x = 4.00\text{ m}$, $y = 3.00\text{ m}$?	05
Q.4A	The resistance of a coil wound on a large transformer is $12\ \Omega$ at 25°C . After the transformer has been in operation for several hours, the resistance of the coil was found to be $13.4\ \Omega$. Find the temperature of the transformer core. Take $\alpha_{20} = 0.00393^\circ\text{C}^{-1}$	05
Q.4B	What do you understand about Superconductivity and the Meissner Effect in this context? Give some example applications of superconductivity.	05
Q.5A	What do you understand by Zone Refining? Explain the Lever Rule by considering the phase diagram between the temperature and composition.	05
Q.5B	Compare the advantages and disadvantages of Thru Hole and Surface Mount PCB-Component Assembly Technology.	05
Q.6A	After adding an impurity atom that donates an extra electron to the conduction band of silicon ($\mu_n = 0.13\text{ m}^2/\text{Vs}$), the conductivity of the doped silicon is measured as $1.08\ (\Omega\text{m})^{-1}$. Determine the doped ratio. (Data: $N_{\text{Avogadro}} = 6.023 \times 10^{23}\text{ atoms/mol}$, $A_{\text{Si}} = 28 \times 10^{-3}\text{ Kg/mol}$, density of silicon is $2,420\text{ Kg/m}^3$). Also comment on the result obtained.	05
Q.6B	Explain the operation of (a) Light Emitting Diode (b) Laser in brief.	05
	OR	
Q.6B	Explain the operation of a Solar Cell.	05
Q.7A	Explain the phenomenon of hysteresis process by drawing a neat sketch with all the labels and definitions.	05
Q.7B	Name the types of crystal growth techniques you are aware. Describe in brief the Czochralski method of crystal growth technique.	05

OR

Q.7B The resistance of a wire is 70Ω at 25°C and 97Ω at 50°C . Find the resistance of wire at 0°C and value of temperature co-efficient at 0°C . 05

Q.8 What do you understand by a printed circuit board (PCB)? Describe the components of PCB in brief. Discuss some of the design issues for PCB. 10

Q.9A For a ferromagnetic material the hysteresis loop second quadrant BH product varies parabolically with H as $BH \text{ (J/M}^3\text{)} = 2.4 H^2 - 5.5 \times 10^{-5} H^3$. Calculate (a) $(BH)_{\text{max}}$ (b) Coercive Field H_c and (c) value of B at $(BH)_{\text{max}}$. 10

Q.9B A parallel plate capacitor has square plates of 50 cm^2 area separated by 10 mm. A slab of Sulphur $\epsilon_r = 4.6$ mm thick is placed on the lower plate, leaving an air gap of 4 mm thick, between the upper plate and Sulphur layer. (a) Calculate the capacitance of the capacitor, neglect fringing. (b) If 100V is applied across the capacitor, find the field in different regions and voltage across the air gap. (c) What shall be the flux density in the two regions? 10

OR

Q.9B (i) Show that for an extrinsic semiconductor material the electron and hole concentration is given by the following two relations: 10

$$n_0 = \frac{1}{2} \{ (N_D - N_A) + ((N_D - N_A)^2 + 4n_i^2)^{1/2} \}, \text{ where } N_D > N_A \text{ (for n-type)}$$

$$p_0 = \frac{1}{2} \{ (N_A - N_D) + ((N_A - N_D)^2 + 4n_i^2)^{1/2} \}, \text{ where } N_A > N_D \text{ (for p-type)}$$

(ii) Determine the thermal equilibrium electron and hole concentrations in a compensated n-type semiconductor. Consider a silicon semiconductor at $T = 300^\circ\text{K}$ in which $N_D = 10^{16} \text{ cm}^{-3}$ and $N_A = 3 \times 10^{15} \text{ cm}^{-3}$. Assume that $n_i = 1.5 \times 10^{10} \text{ cm}^{-3}$.

***** ALL THE BEST *****

