Вариант 04

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **м2. Указания к выбору вариантов задач контрольного задания.**Номер варианта задач 3.1.1 C:\Users\admin\Desktop\COURSE104\img\delenie.gif 3.1.2 и 3.3.1 C:\Users\admin\Desktop\COURSE104\img\delenie.gif 3.3.3 соответствует последней цифре, а номер варианта задач 3.2.1 C:\Users\admin\Desktop\COURSE104\img\delenie.gif 3.2.3 и 3.4.1 C:\Users\admin\Desktop\COURSE104\img\delenie.gif 3.4.2 предпоследней цифре пароля. Все решения сопровождаются подробными пояснениями.**3. Задачи контрольного задания****3.1 Проводниковые материалы*****Задача № 3.1.1***Определить падение напряжения в линии электропередач длиной L при температуре То1 , То2 , То3 , если провод имеет сечение S и по нему течет ток I.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| № вар. | Материал | То1, С | То2, С | То3, С | L, км | S, мм2 | I, А |
| 1 | Al | -50 | +20 | +50 | 50 | 10 | 80 |
| 2 | Cu | -30 | 0 | +30 | 500 | 30 | 250 |
| 3 | Cu | -30 | +25 | +50 | 500 | 25 | 200 |
| 4 | Al | -40 | +10 | +60 | 200 | 10 | 80 |
| 5 | Al | -50 | +20 | +50 | 200 | 5 | 40 |
| 6 | Cu | -30 | 0 | +30 | 500 | 15 | 120 |
| 7 | Cu | -30 | +25 | +50 | 200 | 7,5 | 60 |
| 8 | Al | -40 | +20 | +60 | 200 | 10 | 80 |
| 9 | Al | -50 | +25 | +60 | 100 | 2,5 | 20 |
| 0 | Cu | -40 | 0 | +40 | 50 | 10 | 80 |

***Задача № 3.1.2***Определить длину проволоки для намотки проволочного резистора с номиналом R, и допустимой мощностью рассеяния P.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| № вар. | Материал | R, Ом | P, Вт | j, А/мм2 | C:\Users\admin\Desktop\COURSE104\img\ro.GIF 0, мкОм\* м |
| 1 | Алюминий | 100 | 100 | 0,5 | 0,028 |
| 2 | Х20Н80 | 2000 | 5 | 0,3 | 1,05 |
| 3 | Х15Н60 | 2000 | 5 | 0,1 | 1,1 |
| 4 | Медь | 200 | 100 | 1,3 | 0,0172 |
| 5 | Х20Н80 | 100 | 100 | 1,5 | 1,05 |
| 6 | Алюминий | 2000 | 5 | 0,75 | 0,028 |
| 7 | Х20Н80 | 1000 | 10 | 0,8 | 1,05 |
| 8 | Х15Н60 | 1000 | 10 | 0,1 | 1,1 |
| 9 | Медь | 1000 | 10 | 0,01 | 0,0172 |
| 0 | Алюминий | 200 | 100 | 0,6 | 0,028 |

**3.2 Полупроводниковые материалы*****Задача 3.2.1***Определить концентрацию электронов и дырок в собственном и примесном полупроводнике, содержащем N атомов примеси при комнатной температуре.

|  |  |  |  |
| --- | --- | --- | --- |
| № вар. | Полупроводник материал | примесь | N, см-3 |
| 1 | Si | сурьма | 1014 |
| 2 | Ge | бор | 2 \* 1017 |
| 3 | Si | фосфор | 1015 |
| 4 | Ge | алюминий | 2 \* 1018 |
| 5 | Si | бор | 2,5 \* 1015 |
| 6 | Ge | Фосфор | 1018 |
| 7 | Si | Алюминий | 1016 |
| 8 | Ge | Сурьма | 4,5 \* 1020 |
| 9 | Si | Бор | 3 \* 1015 |
| 0 | Ge | Фосфор | 2 \* 1018 |

***Задача 3.2.2***Образец полупроводникового материала легирован примесью (см. предыдущую задачу). Определить удельную проводимость собственного и примесного полупроводника при заданной температуре Т.

|  |  |
| --- | --- |
| № вар. | То, К |
| 1 | 290 |
| 2 | 300 |
| 3 | 310 |
| 4 | 320 |
| 5 | 330 |
| 6 | 290 |
| 7 | 300 |
| 8 | 310 |
| 9 | 320 |
| 0 | 330 |

***Задача 3.2.3***Определить диффузионную длину движения неравновесных носителей заряда в полупроводниковом материале при заданной температуре То, если время их жизни C:\Users\admin\Desktop\COURSE104\img\tao.GIF .

|  |  |  |  |
| --- | --- | --- | --- |
| № вар. | Материал | То, К | C:\Users\admin\Desktop\COURSE104\img\tao.GIF , мкс |
| 1 | Si - n типа | 290 | 100 |
| 2 | Ge - n – типа | 300 | 50 |
| 3 | Si - p – типа | 310 | 75 |
| 4 | Ge - p – типа | 320 | 120 |
| 5 | Si - n – типа | 330 | 200 |
| 6 | Ge - n – типа | 290 | 250 |
| 7 | Si - p – типа | 300 | 125 |
| 8 | Ge - p – типа | 310 | 80 |
| 9 | Si - n – типа | 320 | 175 |
| 0 | Ge - n – типа | 330 | 50 |

**3. 3 Диэлектрические материалы*****Задача № 3.3.1***Конденсаторная керамика при 20° С имеет проводимость C:\Users\admin\Desktop\COURSE104\img\ksi.GIF ° = 10-13 Сим/см. Какова проводимость C:\Users\admin\Desktop\COURSE104\img\ksi.GIF т при заданной температуре, если температурный коэффициент сопротивления C:\Users\admin\Desktop\COURSE104\img\alfa.GIF = 0,8?

|  |  |
| --- | --- |
| № варианта | Т° , С |
| 1 | 25 |
| 2 | 29 |
| 3 | 32 |
| 4 | 37 |
| 5 | 43 |
| 6 | 35 |
| 7 | 40 |
| 8 | 45 |
| 9 | 50 |
| 0 | 52 |

***Задача № 3.3.2***Определить пробивное напряжение Uпр между электродами конденсатора на рабочей частоте f, если температура, до которой нагревается в электрическом поле диэлектрический материал толщиной h конденсатора, не превышает Токр.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| № вар. | Материал | f, кГц | h, мм | Т, оС | tg C:\Users\admin\Desktop\COURSE104\img\sigma.gif | C:\Users\admin\Desktop\COURSE104\img\alfa.GIF tg C:\Users\admin\Desktop\COURSE104\img\sigma.gif, 1/К | C:\Users\admin\Desktop\COURSE104\img\e.GIF | C:\Users\admin\Desktop\COURSE104\img\Image507.gif |
| 1 | Гетинакс | 10 | 2 | 50 | 0,04C:\Users\admin\Desktop\COURSE104\img\delenie.gif 0,08 | 0,09 | 4,5 | 30 |
| 2 | Картон электроизол. | 100 | 0,5 | 30 | 3 \* 10-4 | 8 \* 10-3 | 1,5 | 15 |
| 3 | Фторопласт | 1000 | 0,06 | 40 | 2 \* 10-4 | 8,6 \* 10-3 | 2,2 | 33,5 |
| 4 | бумага кабельная | 10 | 0,07 | 55 | 3 \* 10-4 | 8 \* 10-3 | 1,2 | 10 |
| 5 | Полиэтилен | 100 | 0,11 | 35 | 2 \* 10-4 | 8,66 \* 10-3 | 2,3 | 30 |
| 6 | Лавсан | 1000 | 0,11 | 45 | 3 \* 10-3 | 1,2 \* 10-2 | 1,2 | 13 |
| 7 | Стеклотекстолит | 10 | 1 | 60 | 2 \* 10-2 | 0,02 | 3,5 | 22 |
| 8 | Бакелит | 10 | 0,2 | 70 | 1 \* 10-2 | 0,05 | 3,0 | 25 |
| 9 | Фторопласт | 1000 | 0,04 | 65 | 2 \* 10-4 | 8,6 \* 10-3 | 2,2 | 35,5 |
| 0 | Бумага | 10 | 0,1 | 75 | 3 \* 10-4 | 8 \* 10-3 | 1,2 | 10 |

***Задача № 3.3.3***Как изменится электрическая прочность воздушного конденсатора, если расстояние между электродами уменьшить от h1 до h2?

|  |  |  |
| --- | --- | --- |
| № варианта | H1, см | h2, см |
| 1 | 1 | 0,1 |
| 2 | 1 | 0,01 |
| 3 | 1 | 0,001 |
| 4 | 0,5 | 0,1 |
| 5 | 0,5 | 0,01 |
| 6 | 0,5 | 0,001 |
| 7 | 10 | 1 |
| 8 | 10 | 0,01 |
| 9 | 10 | 0,1 |
| 0 | 5 | 0,001 |

**3.4 Магнитные материалы*****Задача № 3.4.1***Один из магнитных сплавов с прямоугольной петлей гистерезиса ППГ имеет следующие параметры: поле старта Hо , коэрцитивную силу Hс, коэффициент переключения Sф. Найти время переключения C:\Users\admin\Desktop\COURSE104\img\tao.GIF .

|  |  |  |  |
| --- | --- | --- | --- |
| № варианта | Ho, А/м | Hc, А/м | Sф, мкк/м |
| 1 | 3 | 3 | 14 |
| 2 | 4 | 4 | 16 |
| 3 | 5 | 5 | 18 |
| 4 | 7 | 6 | 20 |
| 5 | 8 | 7 | 22 |
| 6 | 9 | 8 | 24 |
| 7 | 11 | 9 | 26 |
| 8 | 12 | 10 | 28 |
| 9 | 13 | 11 | 30 |
| 0 | 14 | 12 | 32 |

***Задача 3.4.2.***Магнитодиэлектрик выполнен из порошков никелево-цинкового феррита HН400 и полистирола с объемным содержанием магнитного материала C:\Users\admin\Desktop\COURSE104\img\alfa.GIF . Определить магнитную и диэлектрическую проницаемость материала C:\Users\admin\Desktop\COURSE104\img\mu.GIF и C:\Users\admin\Desktop\COURSE104\img\e.GIF , если магнитная диэлектрическая проницаемость магнитного материала C:\Users\admin\Desktop\COURSE104\img\mu.GIF а, C:\Users\admin\Desktop\COURSE104\img\e.GIF мимеет заданные значения. Диэлектрическая проницаемость полистирола C:\Users\admin\Desktop\COURSE104\img\e.GIF Д = 2,5.

|  |  |  |
| --- | --- | --- |
| № варианта | C:\Users\admin\Desktop\COURSE104\img\alfa.GIF | C:\Users\admin\Desktop\COURSE104\img\e.GIF м |
| 1 | 0,1 | 40 |
| 2 | 0,2 | 20 |
| 3 | 0,3 | 60 |
| 4 | 0,4 | 35 |
| 5 | 0,5 | 50 |
| 6 | 0,4 | 25 |
| 7 | 0,3 | 45 |
| 8 | 0,2 | 30 |
| 9 | 0,1 | 65 |
| 0 | 0,5 | 55 |

  |