



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER I  
SESSION 2015/2016**

**COURSE NAME** : SEMICONDUCTOR MATERIAL ANALYSIS

**COURSE CODE** : BED 40702

**PROGRAMME** : BACHELOR OF ELECTRONIC ENGINEERING WITH HONOURS

**EXAMINATION DATE** : DECEMBER 2015 / JANUARY 2016

**DURATION** : 2 HOURS

**INSTRUCTION** : ANSWER ALL QUESTIONS

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

- Q1** (a) This question is based on Figure Q1.
- (i) Identify **TWO (2)** types of chemical bonding. (2 marks)
  - (ii) By the aid of Lewis diagram, give **TWO (2)** examples of different chemical bonding. (4 marks)
- (b) (i) Define the intrinsic and extrinsic semiconductors. (2 marks)
- (ii) Show a schematic diagram of silicon crystal lattice if this material is added with a dopant to form *p*-type semiconductor. (4 marks)
- (c) (i) Define the generation and recombination process of a semiconductor. (2 marks)
- (ii) Show a schematic diagram of energy level for recombination process. (6 marks)
- Q2** (a) Arrange an energy band for a *p*-type Si doped with 1 ppm Boron. (10 marks)
- (b) (i) Explain how an addition of Phosphorus helps to increase the conductivity of silicon. (4 marks)
- (ii) Organize a typical structure of electron movement in silicon crystal lattice when this material is doped with Phosphorus. (6 marks)
- Q3** (a) (i) Illustrate the structural shape of Carbon-Silicon. (3 marks)
- (ii) Name the structural shape of Carbon-Silicon. (1 mark)
- (iii) List **SIX (6)** key properties of Carbon-Silicon compound (6 marks)
- (b) Using a table, demonstrate **THREE (3)** key properties of Silicon-Germanium, Silicon-Tin and Germanium-Tin. (10 marks)

- Q4** (a) Using a table, distinguish the thermal conductivity, band gap and application of Boron Nitride, Aluminium Nitride and Gallium Nitride. (10 marks)
- (b) By the aid of diagram, discuss the direct and indirect band gap. (10 marks)
- Q5** (a) Using a table,  
(i) Outline **SEVEN** (7) compounds from binary II-VI. (7 marks)
- (ii) Indicate the band gap energy of each outlined compound. (7 marks)
- (b) Choose one compound from binary II-VI and analyze the selected compound. (6 marks)

- END OF QUESTION -

FINAL EXAMINATION

SEMESTER / SESSION : SEM I / 2015/2016 PROGRAMME : 4 BEJ  
 COURSE : SEMICONDUCTOR COURSE CODE : BED40702  
 MATERIALS ANALYSIS

**Periodic Table of the Elements**

1 IA 1A		2 IIA 2A												13 IIIA 3A	14 IVA 4A	15 VA 5A	16 VIA 6A	17 VIIA 7A	18 VIIIA 8A																																																																																																																																																																																																																														
Atomic Number		Valence Charge																				Atomic Number		Valence Charge																																																																																																																																																																																																																									
Symbol		Name																				Symbol		Name																																																																																																																																																																																																																									
Atomic Mass																						Atomic Mass																																																																																																																																																																																																																											
1 H Hydrogen 1.008	2 He Helium 4.003																	3 Li Lithium 6.941	4 Be Beryllium 9.012											5 B Boron 10.811	6 C Carbon 12.011	7 N Nitrogen 14.007	8 O Oxygen 15.999	9 F Fluorine 18.998	10 Ne Neon 20.180																																																																																																																																																																																																														
11 Na Sodium 22.990	12 Mg Magnesium 24.305	13 Al Aluminium 26.982	14 Si Silicon 28.086	15 P Phosphorus 30.974	16 S Sulfur 32.065	17 Cl Chlorine 35.453	18 Ar Argon 39.948											19 K Potassium 39.098	20 Ca Calcium 40.078	21 Sc Scandium 44.956	22 Ti Titanium 47.887	23 V Vanadium 50.942	24 Cr Chromium 51.996	25 Mn Manganese 54.938	26 Fe Iron 55.845	27 Co Cobalt 58.933	28 Ni Nickel 58.693	29 Cu Copper 63.546	30 Zn Zinc 65.38	31 Ga Gallium 69.723	32 Ge Germanium 72.631	33 As Arsenic 74.922	34 Se Selenium 78.971	35 Br Bromine 79.904	36 Kr Krypton 84.796																																																																																																																																																																																																														
37 Rb Rubidium 84.461	38 Sr Strontium 87.62	39 Y Yttrium 88.906	40 Zr Zirconium 91.224	41 Nb Niobium 92.906	42 Mo Molybdenum 95.94	43 Tc Technetium 98.906	44 Ru Ruthenium 101.07	45 Rh Rhodium 102.905	46 Pd Palladium 106.42	47 Ag Silver 107.868	48 Cd Cadmium 112.414	49 In Indium 114.818	50 Sn Tin 118.710	51 Sb Antimony 121.757	52 Te Tellurium 127.6	53 I Iodine 126.905	54 Xe Xenon 131.29	55 Cs Cesium 132.905	56 Ba Barium 137.327	57-71 Lanthanide Series	72 Hf Hafnium 178.49	73 Ta Tantalum 180.948	74 W Tungsten 183.84	75 Re Rhenium 186.207	76 Os Osmium 190.23	77 Ir Iridium 192.222	78 Pt Platinum 195.084	79 Au Gold 196.967	80 Hg Mercury 200.59	81 Tl Thallium 204.383	82 Pb Lead 207.2	83 Bi Bismuth 208.980	84 Po Polonium 209	85 At Astatine 210	86 Rn Radon 222.018																																																																																																																																																																																																														
87 Fr Francium 223.021	88 Ra Radium 226.025	89-103 Actinide Series	104 Rf Rutherfordium 261	105 Db Dubnium 262	106 Sg Seaborgium 263	107 Bh Bohrium 264	108 Hs Hassium 265	109 Mt Meitnerium 266	110 Ds Darmstadtium 267	111 Rg Roentgenium 268	112 Cn Copernicium 269	113 Uut Ununtrium 270	114 Fl Flerovium 271	115 Uup Ununpentium 272	116 Lv Livermorium 273	117 Uus Ununseptium 274	118 Uuo Ununoctium 276	119 Uuq Ununquadium 277	120 Uuq Ununquadium 278	121 Uuq Ununquadium 279	122 Uuq Ununquadium 280	123 Uuq Ununquadium 281	124 Uuq Ununquadium 282	125 Uuq Ununquadium 283	126 Uuq Ununquadium 284	127 Uuq Ununquadium 285	128 Uuq Ununquadium 286	129 Uuq Ununquadium 287	130 Uuq Ununquadium 288	131 Uuq Ununquadium 289	132 Uuq Ununquadium 290	133 Uuq Ununquadium 291	134 Uuq Ununquadium 292	135 Uuq Ununquadium 293	136 Uuq Ununquadium 294	137 Uuq Ununquadium 295	138 Uuq Ununquadium 296	139 Uuq Ununquadium 297	140 Uuq Ununquadium 298	141 Uuq Ununquadium 299	142 Uuq Ununquadium 300	143 Uuq Ununquadium 301	144 Uuq Ununquadium 302	145 Uuq Ununquadium 303	146 Uuq Ununquadium 304	147 Uuq Ununquadium 305	148 Uuq Ununquadium 306	149 Uuq Ununquadium 307	150 Uuq Ununquadium 308	151 Uuq Ununquadium 309	152 Uuq Ununquadium 310	153 Uuq Ununquadium 311	154 Uuq Ununquadium 312	155 Uuq Ununquadium 313	156 Uuq Ununquadium 314	157 Uuq Ununquadium 315	158 Uuq Ununquadium 316	159 Uuq Ununquadium 317	160 Uuq Ununquadium 318	161 Uuq Ununquadium 319	162 Uuq Ununquadium 320	163 Uuq Ununquadium 321	164 Uuq Ununquadium 322	165 Uuq Ununquadium 323	166 Uuq Ununquadium 324	167 Uuq Ununquadium 325	168 Uuq Ununquadium 326	169 Uuq Ununquadium 327	170 Uuq Ununquadium 328	171 Uuq Ununquadium 329	172 Uuq Ununquadium 330	173 Uuq Ununquadium 331	174 Uuq Ununquadium 332	175 Uuq Ununquadium 333	176 Uuq Ununquadium 334	177 Uuq Ununquadium 335	178 Uuq Ununquadium 336	179 Uuq Ununquadium 337	180 Uuq Ununquadium 338	181 Uuq Ununquadium 339	182 Uuq Ununquadium 340	183 Uuq Ununquadium 341	184 Uuq Ununquadium 342	185 Uuq Ununquadium 343	186 Uuq Ununquadium 344	187 Uuq Ununquadium 345	188 Uuq Ununquadium 346	189 Uuq Ununquadium 347	190 Uuq Ununquadium 348	191 Uuq Ununquadium 349	192 Uuq Ununquadium 350	193 Uuq Ununquadium 351	194 Uuq Ununquadium 352	195 Uuq Ununquadium 353	196 Uuq Ununquadium 354	197 Uuq Ununquadium 355	198 Uuq Ununquadium 356	199 Uuq Ununquadium 357	200 Uuq Ununquadium 358	201 Uuq Ununquadium 359	202 Uuq Ununquadium 360	203 Uuq Ununquadium 361	204 Uuq Ununquadium 362	205 Uuq Ununquadium 363	206 Uuq Ununquadium 364	207 Uuq Ununquadium 365	208 Uuq Ununquadium 366	209 Uuq Ununquadium 367	210 Uuq Ununquadium 368	211 Uuq Ununquadium 369	212 Uuq Ununquadium 370	213 Uuq Ununquadium 371	214 Uuq Ununquadium 372	215 Uuq Ununquadium 373	216 Uuq Ununquadium 374	217 Uuq Ununquadium 375	218 Uuq Ununquadium 376	219 Uuq Ununquadium 377	220 Uuq Ununquadium 378	221 Uuq Ununquadium 379	222 Uuq Ununquadium 380	223 Uuq Ununquadium 381	224 Uuq Ununquadium 382	225 Uuq Ununquadium 383	226 Uuq Ununquadium 384	227 Uuq Ununquadium 385	228 Uuq Ununquadium 386	229 Uuq Ununquadium 387	230 Uuq Ununquadium 388	231 Uuq Ununquadium 389	232 Uuq Ununquadium 390	233 Uuq Ununquadium 391	234 Uuq Ununquadium 392	235 Uuq Ununquadium 393	236 Uuq Ununquadium 394	237 Uuq Ununquadium 395	238 Uuq Ununquadium 396	239 Uuq Ununquadium 397	240 Uuq Ununquadium 398	241 Uuq Ununquadium 399	242 Uuq Ununquadium 400	243 Uuq Ununquadium 401	244 Uuq Ununquadium 402	245 Uuq Ununquadium 403	246 Uuq Ununquadium 404	247 Uuq Ununquadium 405	248 Uuq Ununquadium 406	249 Uuq Ununquadium 407	250 Uuq Ununquadium 408	251 Uuq Ununquadium 409	252 Uuq Ununquadium 410	253 Uuq Ununquadium 411	254 Uuq Ununquadium 412	255 Uuq Ununquadium 413	256 Uuq Ununquadium 414	257 Uuq Ununquadium 415	258 Uuq Ununquadium 416	259 Uuq Ununquadium 417	260 Uuq Ununquadium 418	261 Uuq Ununquadium 419	262 Uuq Ununquadium 420	263 Uuq Ununquadium 421	264 Uuq Ununquadium 422	265 Uuq Ununquadium 423	266 Uuq Ununquadium 424	267 Uuq Ununquadium 425	268 Uuq Ununquadium 426	269 Uuq Ununquadium 427	270 Uuq Ununquadium 428	271 Uuq Ununquadium 429	272 Uuq Ununquadium 430	273 Uuq Ununquadium 431	274 Uuq Ununquadium 432	275 Uuq Ununquadium 433	276 Uuq Ununquadium 434	277 Uuq Ununquadium 435	278 Uuq Ununquadium 436	279 Uuq Ununquadium 437	280 Uuq Ununquadium 438	281 Uuq Ununquadium 439	282 Uuq Ununquadium 440	283 Uuq Ununquadium 441	284 Uuq Ununquadium 442	285 Uuq Ununquadium 443	286 Uuq Ununquadium 444	287 Uuq Ununquadium 445	288 Uuq Ununquadium 446	289 Uuq Ununquadium 447	290 Uuq Ununquadium 448	291 Uuq Ununquadium 449	292 Uuq Ununquadium 450	293 Uuq Ununquadium 451	294 Uuq Ununquadium 452	295 Uuq Ununquadium 453	296 Uuq Ununquadium 454	297 Uuq Ununquadium 455	298 Uuq Ununquadium 456	299 Uuq Ununquadium 457	300 Uuq Ununquadium 458	301 Uuq Ununquadium 459	302 Uuq Ununquadium 460	303 Uuq Ununquadium 461	304 Uuq Ununquadium 462	305 Uuq Ununquadium 463	306 Uuq Ununquadium 464	307 Uuq Ununquadium 465	308 Uuq Ununquadium 466	309 Uuq Ununquadium 467	310 Uuq Ununquadium 468	311 Uuq Ununquadium 469	312 Uuq Ununquadium 470	313 Uuq Ununquadium 471	314 Uuq Ununquadium 472	315 Uuq Ununquadium 473	316 Uuq Ununquadium 474	317 Uuq Ununquadium 475	318 Uuq Ununquadium 476	319 Uuq Ununquadium 477	320 Uuq Ununquadium 478	321 Uuq Ununquadium 479	322 Uuq Ununquadium 480	323 Uuq Ununquadium 481	324 Uuq Ununquadium 482	325 Uuq Ununquadium 483	326 Uuq Ununquadium 484	327 Uuq Ununquadium 485	328 Uuq Ununquadium 486	329 Uuq Ununquadium 487	330 Uuq Ununquadium 488	331 Uuq Ununquadium 489	332 Uuq Ununquadium 490	333 Uuq Ununquadium 491	334 Uuq Ununquadium 492	335 Uuq Ununquadium 493	336 Uuq Ununquadium 494	337 Uuq Ununquadium 495	338 Uuq Ununquadium 496	339 Uuq Ununquadium 497	340 Uuq Ununquadium 498	341 Uuq Ununquadium 499	342 Uuq Ununquadium 500

© 2015 Todd Helmenstein  
 toddhelmenstein.org

FIGURES Q1