

%
Z/3, %!6!23, >9.4!<XH!ki YS(; -94.92!Z3, ; .9T, !Qd' 3, 449/-4!C\@"!\$##!; ->!<L"!#k&F!!539.9-J`Q-E; -2, >!
%-&?- \$ \$ " !##%#7 *%#&! ! ! ! ! !!

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= / > ; : 9 . ? % @ - ! ' , 3 4 / - 0 ! I , D ` ; 4 4 9 4 . , > !

!

/ O 1 2 3 4 \$ (4 3 6 2 7 8 9 7 0 : ; ! < ! 4 . S > ? ! / G ! : 9 h S 9 > 4 ! ; - > ! 4 / : S . 9 / - 4 0 ! , : , 2 . 3 / : ? . , 4 0 ! ; 2 9 > ` D ; 4 , ! . E , / 3 ? 0 ! V 9 - , . 9 2 4 0 ! , h S 9 : 9 D 3 9 S (0 !
, : , 2 . 3 / 2 E , (9 4 . 3 ? ! ; - > ! > , 4 2 3 9 ' . 9 T , ! 2 E , (9 4 . 3 ? ! / G ! 3 , ' 3 , 4 , - . ; . 9 T , ! (, . ; : : 9 2 ! ; - > ! - / - `

%

@2424a173794;!!<ZZ!\$7*!CI 9.EI<ZZ!\$7k!.;V, -!2/-2S33, -.:?F!; ->!QZX!#76!; ->!="!#7k!; ->!="!##8!; ->! b' ', 3!B/' E/(/3,

%
Z/3, %!RS:G9::4!<3, ;!/GIH-/I : ,>J, !@i Z9T92!Q-J; J, (, -.!
%>-. . \$! ! "16#7' (`M%77' (H, 44:, 30!QU
=/>;:9.?%X-:9-, !B?-2E3/-/S4!C/3!2/S:>!D, !5, D': 4494., >Fg!
!
/O1234\$(436278970: ;!" E94!2/S34, !, d' :/3, 4! .E, !3, 4, ; 32E!; ->! .E, /39, 4!/GI, GG, 2.9T, !:, ;>, 34E9' U" E, !G/::/I 9-J!
./' 924!; 3, !4.S>9, >!G3/(!.E, !' , 34' , 2.9T, !/GI/D/.E! .E, !:, ;>, 3!; ->!J3/S' ! (, (D, 34% ; 44, 3.9-J!; S.E/39.?%DS9:>9-J!
2/((9. (, - .!J; 9-9-J! /I , 30!9-.3/>S29-J!2E; -J, !E; ->:9-J!2/-G3/-.; .9/-!; ->!; ., 3; :!3, :: .9/-4U
\$
dddddddddddddddddddddddddddddddddd\$
@!_#%?%\$ \$ C73902E\$OG\$(7S42379Ef, a179E\$7: \$! J 42!\$, : 9429D7: J 4: 9\$ \$ \$ *1234!
<3, ;!/GIH-/I : ,>J, !@! /3!<3, ;!/GIH-/I : ,>J, !@K\$ \$
%)B%)\$ \$ \$ R!%*7' (!)!6*7' (! ! !
=/>;:9.?%X-:9-, !Bn_ZY LX_XbB!! !
\$
/O1234\$(436278970: ;\$\$ E94!2/S34, !, d; (9-, 4!-S (, 3/S4! (/T, (, -.4!9-! .E, !4.3SJJ:, !G/3!>9T, 349.?!; ->! , hS; :9.?!
9-!D/.E! .E, ; , 3!; ->!G9: (U@!, d; (9-, 4!3; 29; :i , -E-92!E94./3?!; ->!>?;-; (9240! /:9.9240!; ->! (; 3V, .! :; 2, !3, ; :9.?!; ->!
' , 32, ' .9/-0!; 4!I , ::!; 4!/ .E, 3!G; 2./34!9-G:S, -29-J!>9T, 349.?!; ->! , hS9.?!
!
dddddddddddddddddddddddddddddddddd\$
@C!\$--)\$ \$! : 674: 9\$@P7!N0308PE\$T/ND3376DN\$/7SV\$ \$ \$ \$ \$ *1234!
<3, ;!/GIH-/I : ,>J, !@! 539.9-J!Q-E; -2, >\$ \$
%). -%\$ \$ =5!\$%&&! (!)!k%\$7' (! ! ! ! ! ! L; SD92E, 2V!5U
=/>;:9.?%X-:9-, !4?-2E3/-/S4!
\$
@246424: 64\$07S4: \$90\$CO: 023\$G243PJ 4: !\$\$<9P42\$CO: 023\$39154: 93\$J DE\$9DI 4\$9P73\$6O1234\$O: NE\$R79P\$
D8820SDM\$
/O1234\$(436278970: ;\$\$<-! , d' :/3; .9/-!/GI; -29, -.! ' ; ... 3-4!/GI.E/SJE.!; ->!E/I !.E, ?!, (, 3J, >!9-!3, 4' /-4, !./!
ES (; -! , d' , 39, -2, !G3/(!; D/S.!677!+!Z!U!./!; D/S.!\$77!Z!U! =; f/3! .E, (, 4!G/2S4!/-!hS, 4.9/-4!; D/S.!E/I !I , !
2/(, !./V-/I !; D/S.!/S3!I /3:>! .E, !3, ; :.9/-4E9' 4!D, .I , , -! .E, !J/>4!-; .S3, !; ->! (; -!; ->!/-!ES (; -!2/-2, 3-4!
! 9.E! , .E92; :!; ->! /:9.92; :!944S, 4U
!
dddddddddddddddddddddddddddddddddd\$
@_]\$%)\$ \$ @3E6PONOOE\$OG\$/7S76\$, : ODO4J 4: 9\$ \$ \$ \$ \$ \$ *1234!
<3, ;!/GIH-/I : ,>J, !@i Z9T92!Q-J; J, (, - .!3, hS93, (, -.!
%- ' >-\$ \$! X_\@_Q] 555! ! ! ! ! !

%
 <3, ;!G!H-/I ;, >J, !@@/3!K!
 %)?. ?\$ \$ \$ "L!#\$%#&' (!)!#%k7' (! ! ! ! ! ! ! ! ;?; V0! =U
 =/>; :9.?%!@-!' , 34/-0!5, D!; 4494., >!
 \$
 /O1234\$(436278970: ;\$" E94!2/S34, !, d; (9-, 4!.E, !2/(' : , d!9-, , 34, 2.9/-4!/G!J, -, >, 30!3; 2, i , .E-929.?0!2; 440!; ->!
 4, dS; :!/39, -, ;.9/-0!; (/-J!/.E, 3!T, 2./34!/G!>9T, 349.?!9-!.E, !b-9., >!B.; , , 40!; 4!I , :!; 4!J:/D; ::?U@.!/GG, 34!
 4/29/;/J92; :!' , 34' , 2.9T, 4!/;-!;-S(D, 3!/G!944S, 4!3; -J9-J!G3/(!4/29; :!9-, hS; :9.9, 4!)!4S2E!; 4!.E, !(; 44!
 9-2; 32, 3; .9/-!/G!<G392; -!<(, 392; -!(, -!)!./!D; 492! 94(4!)!4S2E!; 4!4, d94(0!3; 294(0!2; : 4494(0!/3!; D; , 94(!)!./!
 3, ; :.9T, !' 39T9; , J, 4!; ->!>94; >T; -; , J, 4!.E; .!I , !; ::!E; T, !)!4S2E!; 4!I , ; :.E!>94' ; 39.9, 4!; ->!E, 93!E, ; :.E!; ->!
 , >S2; .9/-; :!2/-4, hS, -2, 4U@-!' ; 3.92S; :30!.E, !2/S34, !2E3/-92; 4!.E, !9T, >! , d' , 39, -2, 4!/G!I / (, -!; 3/S->!E, !
 ! /3; >!G3/(!; -!; -.E3/' /;/J92; :i 2S; .S3; :!' , 34' , 2.9T, !)!4S2E!; 4!G, (; :. !J, -9.; :!2932S(2949/-0!4, dS; :! , d' :/9.; .9/-0!
 ; ->!I / (, -0! , T, 3' 2E; -J9-J!3/; , 4!; .!E/(, !; ->!9-!.E, !; :D/3!G/32, U

#HESIS COURSES

+20J \$9P4\$Z137: 433\$CO: 023\$@2002DJ \$G02\$DN\$RPO\$D24\$507: 0\$9P472\$9P4373\$R79P\$ZC@\$TDNN\$6012343\$) \$62457930\$
 60: 31N9\$R79P\$9P4\$ZC@\$G02\$2407392D970: \$549D7N3V;!
 <ZZ!kM&!!!! B, -9/3![3/f, 2.19-!<22/S-.9-J!!!! ! ! ! ! ! ! ! !
 R@_!kM&!!!! B, -9/3![3/f, 2.19-!R9-; -2, !!!!!
 =m"!kM&!!!! B, -9/3![3/f, 2.19-! =; -; J, (, - .!!!!
 =<L!kM&!!!! B, -9/3![3/f, 2.19-! =; 3V, .9-J!!
 !

C" E, 4, !2; : 44, 4!; 3, !/' , -!.!; :!4.S>, -.40!DS.!Y/-/34!4.S>, -.4! I E/!.; V, !.E, (!I 9; :!D, !; D; .!./!2/S-.!.E, (!; 4!/-, !
 2/S34, !./! / ; >! .E, 93!3, hS93, >!-S(D, 3!/G!Y/-/34!2/S34, 4F!
 !

C

WH#\$%#&' g! ! /ND3376DN\$ 4D697: 0\$90\$9P4\$ D39\$ \$ \$! ! ! ! 6!234U
 Z/3, %!RS:G9; :4!*!23, >9.4!/G!<3, ; !/G!H-/I ;, >J, !@@; ->! 23, >9.4!/G!<3, ; !/G!H-/I ;, >J, !@K! I 39.9-J` , -E; -2, >!
 %)?)&\$! ! "L!#\$%#&' \$%#&' (! ! ! ! ! XGGS..0!+i L, ; J9-0!_!!
 =/>; :9.?%!X-.9-, !=@A<B!
 !
 (436278970: %" E94!2/S34, !G, ; .S3, 4!-, ! !; ->!; >>9.9/-; :!E94./392; :!49(S; .9/-4!G3/(!.E, !jL, ; 2.9-J!./!.E, ! [; 4. j!
 4, 39, 4P! ' , 3G, 2.!G/3! .E/4, ! 4.S>, -.4! I E/! , -f/?! 9(' 3/T, ! ; 2.9-J! /3! /-:9-, ! J; (9-JU B.S>, -.4! I 9; :! 9((, 34, !
 .E, (4, :T, 4!9-!.E3, !D; 2V` ./D; 2V!49(S; .9/-4!4, .!; .!V, ?!' /9-.4!9-!.9(, 0!3, 2, 9T9-J!2E; 3; 2., 3!3/; , 4!; ->!T92./3?!
 /Df, 2.9T, 4! I E9; !G; 29-J! .E, !V-/! ;, >J, !; ->!2E/92, 4!; T; 9; D; !./! .E, !' , /' ; !; :9T, !; !.E, !.9(, U B.S>, -.4! I 9; :!
 9((, 34, !.E, (4, :T, 4!9-!.E, !.9, 3; .S3, 0! E94./3?0! /:9.9240! ; ->! ' E9;/4/' E?! /G! 2; : 4492; :! <.E, -4!; ->! .! /!/.E, 3!
 (/ (, -.4!/G!S' E; , T; :!; ->!2/-., -.9/-U! "E, !., 3(!p2; : 4492; :q!(, 3, :?!2/--/, 4!; /-J

%

; ->!B23, , -!B.S>9, 4!' /3.9/-! | 9:;! ' 3/T9>, !; !.E, /3, .92; :!9-.3/>S2.9/-! ./!E/I ! (, >9; !2S:.S3, !; ->!4S3T, 9::; -2, !
2S:.S3, !; 3, !9-. , 3. | 9-, >0!; ->! .E3/SJE!2:/4, !3, ; >9-J4! /G! 69; (4!.E; !S4, !4S3T, 9::; -2, !; 4!; !.E, (, 0! ' 3/2, 44!E/I !

%

/W_-\$->%]\$ \$ (4370: \$#P7: 17: 0\$D: 5\$W: : OSD970: \$ \$ \$ \$ \$ *!234U
<3, ;!/G!H-/I :, >J, !@!539.9-J!Q-E; -2, >!
%%*)B\$ \$ \$ L!#7%7&; (!)!#\$%7&' (! ! !

%

A! ` \$)%>\$ \$ (7079DN\$=457D\$ADR\$ \$ \$ \$ \$ \$ \$ \$ \$)623\$
%%&&>\$ \$ =5!#7%*& (!)#!\$%77' (! ! ! ! ! =; J; :>90!1
=/>; :9.?%!5, D'; 4494., >!

!

/O1234\$(436278970:;! " E, !2/S34, !I 9::!9-.3/>S2, !E, !4.S>, -.!. /!.E, !:, J; !: ->!3, JS:: ./3?!, -T93/- (, -!. /G!
2/ (' S., 3!, 2E- /: /J?0!, 4', 29; ::? !944S, 4!2/-2, 3-9-J!.E, !@-. , 3-, .! < (/-J!.E, !./ ' 924!. /!D, !2/T, 3, >!E; .!; 3, !
>93, 2.:? !3, ;, >! .! /!.E, !@-. , 3-, .!; 3, %9-.3/>S2.9/-.! /!2/ (' S., 34!; ->!FS>929; :!>, 2949/-4!2/-2, 3-9-J!2?D, 34' ; 2, !P
FS394>92.9/-; :!hS, 4.9/-4!2/-3; 2.4!9-2:S>9-J!>9J9.; :!49J-; .S3, 40!./3.!.; 4', 2.4!239 (9-; !:; ! 4!; GG, 2.9-J!.E, !
@-. , 3-, .!2?D, 3', 33/394 (0!9-. , ;, 2.S; :! ' 3/ , 3.? !39JE.4!C2/ ' ?39JE.40!.3;>, (; 3V40! ; ., -.40!; ->!3; >, !4, 23, .4F0!
' 39T; 2?!; ->! , E92; :!944S, 40!.; d; .9/-! /G!@-. , 3-, .!4; ;, 40!4, 2S39.9, 40!; -.9.3S4.0! (' :/? (, -.0!; ->!4, 2S39.? !944S, 40!

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dddddddddddddddddddddddddddddddddd\$
AW#%\$-%i \$ \$ _915743\$7: \$/OJ 763\$D: 5\$[2D8P76\$HOS4N3 *!234!
<3, ;! /G!H- /! : , >J, !@! /3!@Ki 539.9-J!Q-E; -2, >!
%*%*->! ! ! =5!#7%*& (!)#!\$%77' (! ! ! ! ! \, T9.a0! [U
=/>; :9.?%!X-:9-, !Bn_ZY LX_XbB!

!

/O1234\$(436278970: ;\$m3; ' E92!;9., 3; .S3, !94!; !G3, 4E!; ->!G; 4. J3/! 9-J!G/3 (!9-!< (, 392; !./>; ?U Y/! , T, 30!S-:9V, !
:/-J , 4.; D:94E, >!;9., 3; 3? !G/3 (40!9. !94!/-: ?!D, J9--9-J!./!3, 2, 9T, !.E, !; ., -.9/-!9. !>, 4, 3T, 40!B.S>, -.4! ! 9::!3, ; >!; ->!
; -; :?a, !2/ (924!; ->!J3; ' E92!- /T, :4!G/3!; >S: .4!; ->!., -; J, 34!; ->! , d' :/3, !, d' , 39 (, -; :!G/3 (4! /G!J3; ' E92!
4./3?., :9-J!9-!239.92; ::? ; 22; 9 (, >! ! /3V4!4S2E!; 4!RS-!Y/ (, 0! =; 32E0!; ->!L; >9/; 2.9T, 0!; ->!9-! , d2, 3' .4!G3/ (!
/ .E, 3! ' 9, 2, 40!mS9>, 4!4S2E!; 4! .E, !J3; ' E92! (; -S; :!Y/! !./!L, ; >!_ ; -2? !I 9::!E, :! !4.S>, -.4!S->, 34.; ->!; ->!
, T; :S; ., !J3; ' E92! ! /3V!; 4!; !:9., 3; 3? !G/3 (U !

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dddddddddddddddddddddddddddddddddd\$
AW#%\$&>" \$ \$ \$+D72E\$#DN43;\$=4574SDN\$90\$=0542: \$ \$ \$ \$ \$ \$ \$ *!234!\$
%*%*&\$ \$! " !#7%*&!)#!\$%77' (! ! ! ! ! ! O39T, 30! =U
<3, ;! /G!H- /! : , >J, !@! /3!@Ki 539.9-J!Q-E; -2, >!
=/>; :9.?%!X-:9-, !=@A<B!

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/O1234\$(436278970: ;\$B.S>, -.4!9-!.E94!2/S34, !I 9::!3, ; >!G; (/S4!G; 93?!. ; , 4!; ->!4.S>?! .E, 93! , ; 3:9, 4. !E94. /3?0!
; -; :/JS, 40!; ->!; ., 3!3, ! 39.9-J40!; :-J! ! 9.E!3, ;, >!G9; (40!B. /39, 4!./!D, !2/-49>, 3, >! (; ?!9-2:S>, !j+, ; S. ?!; ->!
.E, !+, ; 4.0j !jB- /! !5E9., 0j !j Z9->, 3, ;, 0j !j " E, !\9. ., ! =, 3 (; 9>0j !j L, >!L9>9-J!Y//>0j !; ->!jB: , , ' 9-J!+, ; S. ?0j !
; (/-J!/.E, 340!B.S>, -.4! ! 9::!; ; 3-!; D/S.!.E, !E94. /3?!, ->!2S: .S3; :!2/-., d.4! /G!G; 93?!. ; , 40!<449J-, >!; S.E/34!
2/S:>!@-2:S>, !.E, !; - /-? (/S4! ! 39., 3! /G!j [, 32, G/3, 4.0j !m, /GG3, ?!ZE; S2, 30!59:9; (!BE; V, 4' , ; 3, 0!ZE; 3; 4!
[, 33; S: .0!.E, !+3/ .E, 34!m39 (0!Y; -4!ZE394.9; -!<->, 34, -0!L, ; 9>!O; E:0!<-J, ; !Z; 3., 30!<-- , !B, d. /-0! =; 3J; 3, .!
<. ! //>0! =; 39-; !5; 3-, 30!; ->! / .E, 340!R9: (4!G/3!4.S>?! (9JE. !9-2:S>, !1, ; -!Z/2., ; Sc4!j+, ; S. ?!; ->! .E, !+, ; 4.cc!; ->!
jB: , , ' 9-J!+, ; S. ?j !>93, 2., >!D? !Z; .E, 39-, !+3, 9:: .0! ! 9.E! /449D: , !D39, G!2/ (' ; 3; .9T, !2:9' 4!G3/ (!O94-, ?U " E94!
2/S34, !G\$G9:4!<XH!\$! /3!k0!; ->!5QZ!3, hS93, (, -.4!; ->!2; -!; :4/!D, !S4, >!; 4!; -! , : , 2.9T, !9-!.E, !5mB! (; f/3! /3!
(9- /30! !

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667\$! 819: ; <=>?0@: \$<8>/?: ?\$

@@! \$J Db023\$D24\$DNNOR45\$O: NE\$%\$OG\$9P434\$: O: c4^6N137S430\$D: 5\$D: E\$CO: O23\$O8970: 3\$J 139\$50: 4\$<i #_W(, \$OG\$
@@! \$6012343!

%
@! +#\$)B%\$ \$ \$ #4M4S7370: \$C73902E\$
\$
@! [, \$-B>\$ \$ \$