Ref. no. : Ex/ET/T/424/2017(Old)

# B.E.ELECTRONICS & TELECOMMUNICATION ENGINEERING

## FOURTH YEAR SECOND SEMESTER (old)-2017

## INDUSTRIAL ELECTRONICS

*Full Marks =100* *Time : 3 Hours*

**Answer Q.1** and any **FOUR** from the rest
(Assume all rectifiers AC-mains operated ; unless stated otherwise)

**1.** Indicate True(**T**)/ False(**F**) : 10x2

i. A single-phase HW-rectifier uses 1:4 step-up transformer with a diode (D); the PIV across D is 2.1 KV
ii. Efficiency of a HW-rectifier is 12% if load $R_L$= 1KΩ and $r$ (diode) = 600Ω
iii. A HW-rectifier uses a transformer with 2KVA rating ; DC power to a resistive load without overheat is 573 W
iv. Depth of penetration in Induction Heating is $\delta = (\rho / \mu^2)$ @ 15MHz
v. Heat power on a non-magnetic load surface is $\Delta p = 160 (\beta^2 \sqrt{\rho})$ @ 16MHz
vi. For a 6-$\Phi$ rectifier $I_{dc}$ = 20.1 mA if $R_L$= 1KΩ
vii. In a m-$\Phi$ rectifier dc output voltage is $E_{dc} = 230 \sin(\pi/m)$
viii. A programmable logic controller is essentially a Multiplexer
ix . A relaxation oscillator using UJT( $\eta$=0.5), C =14.5 nF and R= 1KΩ generates pulse-waves of period = 1.5 ms.
x. A FW-rectifier with LC-filter becomes unstable if L=25mH and C= 100μF

**2.** a. Explain operation of a full-wave (FW) rectifier with a neat circuit diagram 6+8+6
b.Derive an expression for Ripple-Factor ($\gamma$) with RC-filter
c. Desired $\gamma$ = 2% with R=1K Ω and diode conduction angle = 10°. Determine C(μF)

**3.** a. What is a Multiphase rectifier 4+4+12
b.Define : (i) Efficiency (ii) $P_{dc}$
c. Determine $P_{dc}$ and $E_{dc}$ for a 4 – $\Phi$ rectifier assuming $R_L$= 10KΩ

**4.** a. Explain the characteristics of a silicon controlled rectifier (SCR) 6+6+8
b. How the operation of a TRIAC differs from the SCR
c. A *SCR* operates on AC-mains line to get $I_{dc}$ = 5 mA @ load $R_L$= 10KΩ. Determine Firing Angle

**5.** a. Explain operation of Push-Pull Power Inverter (PPPI) 8+12
Given for a PPPI : A = 4cm$^2$, B=4K.gauss, $f$=3.6KHz, $V_{cc}$=15$V_{dc}$ and $V_{be}$ =2v (winding) and secondary N = 50 turns.
Determine (i) Peak output voltage (ii) Total number of Primary turns.

[ Turn over

6. a. What is a PLC 6+14
   b. A process system involves four variables (A, B, C, D)controlled by a PLC : Show a logic control diagram for 'ENERGIZE' Alarm Signal (Y) *if A=0 and*
   *Either B= 1 AND C=0 OR D=1*

7. a. Define 8+6+6
   (i) '*Resistance*' for a liquid level system
   (ii) Time constant of a Thermal system
   b. Consider a typical first-order Thermal system wherein liquid in a tank is heated by heat input ($H_i$) resulting to temperature rise ($\theta_o$) of the liquid. Formulate the transfer function $F = \theta_o / H_i$.
   c. Sketch response of $\theta_o(t)$ assuming a sudden step-change in $H_i$ applied at t = 0. Calculate value of $\theta_o(t)\big|_{t=\tau}$ as percent of steady state $\theta_o$.

8. Write Short Note (Any Two) : 10+10

   a. Bridge Rectifier
   b. Induction Heating
   c. LC-commutation for SCR turn-Off
   d. Resistance Weld
   e. Function XOR by Relay ladder logic.
   f. Cycloconverter

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