

JK LAKSHMIPAT UNIVERSITY, JAIPUR

INSTITUTE OF ENGINEERING AND TECHNOLOGY

End Term Examination, May 2019
B. Tech. I Year Second Sem. (Common to all Branches)

Roll No.....

OPEN BOOK

COURSE CODE: BES 202
Fundamentals of Automation Engineering

Time: 3 hours Max. Marks: 60

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.1(A) Truth table for function $F(x,y,z)$ is given below. 5

- LO-U3-1
- Write the expression for $F(x,y,z)$ in (a) SOP form (b) POS form.
 - Draw the logic circuit diagram for both forms of the expression.

x	y	z	$F(x,y,z)$
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	1

Q1 (B) Find the complement of the Boolean expression and reduce it to minimum number of literals using postulates and theorems of Boolean algebra. 5

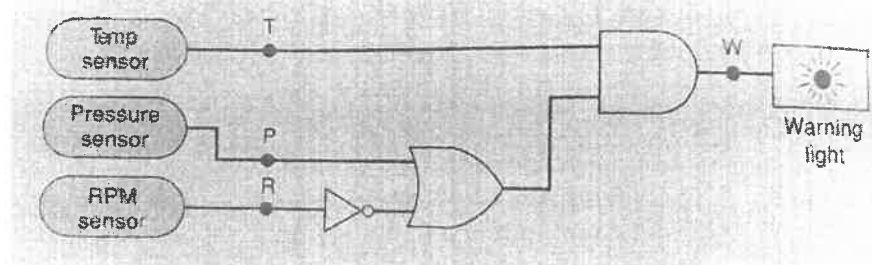
- LO-U3-1
- $B'D + A'B'C' + ACD + A'BC$

Q.2(A) A jet aircraft employs a digital system for monitoring the Speed, Pressure and Temperature values of its engine, using sensors that operate as follows: 5

- LO-U3-2
- RPM sensor **R**, output = 0 only when Speed < 4800 rpm
 - Pressure sensor **P**, output = 0 only when Pressure < 220 psi
 - Temp sensor **T**, output = 0 only when the Temperature < 220° F

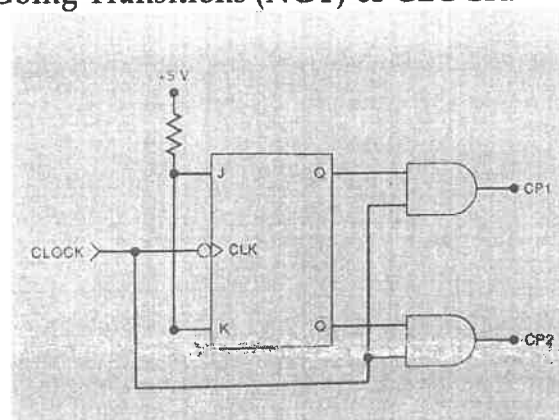
Figure below shows the logic circuit that controls the cockpit warning light for certain combinations of engine conditions. Assume that a HIGH at output **W** activates the warning light.

- (i) Determine what engine conditions will give a warning to the pilot.
- (ii) Change this circuit to one using only NAND gates.

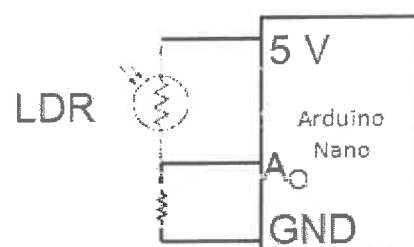


Q 2(B) Using K-map, simplify the Boolean function $F(w, x, y, z) = \Sigma (1, 3, 7, 11, 15)$, 5
 LO-U3-2 which has Don't cares $d(w, x, y, z) = \Sigma (0, 2, 5)$.
Draw the logic diagram for the minimized function.

Q 3(A) The JK flip shown below is used to generate two non-overlapping clock 5
 LO-U3-2 pulses, CP1 and CP2, for a microprocessor system. Assuming $Q=0$ initially, **draw the timing diagram for CLOCK, CP1 and CP2. Describe what happen at the Negative Going Transitions (NGT) of CLOCK.**



Q3(B) The figure below shows a Light Dependent Resistor (LDR) connected to an 5
 LO-U4-3 Arduino Nano. Note that A_0 is an analog input. This circuit is used to detect intensity of light inside a smart energy-efficient greenhouse. **Write an Arduino program to continuously monitor the light intensity and display the message "Bright or Dark" on Serial Port as appropriate. Mention any assumption made.**



- Q.4(A) The operation of a temperature control system for an electrical furnace can be described as follows: according to the desired temperature T_d , selected by the operator, an Arduino Nano sends out a voltage V_1 , to an amplifier, which converts V_1 into another voltage V_2 ($V_2 > V_1$). Finally, the heater converts V_2 into temperature T , by resistance elements lining the interior of the furnace. 5
- LO-U2-1
- LO-U4-2

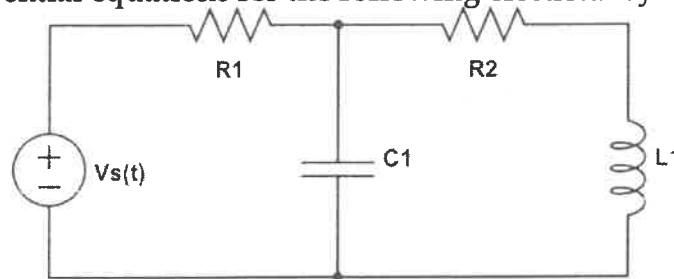
Draw a block diagram for this control system, identifying the input and output variable of each sub-system.

- Q.4(B) A material handling machine can be described by the following equations: 5
- LO-U2-1

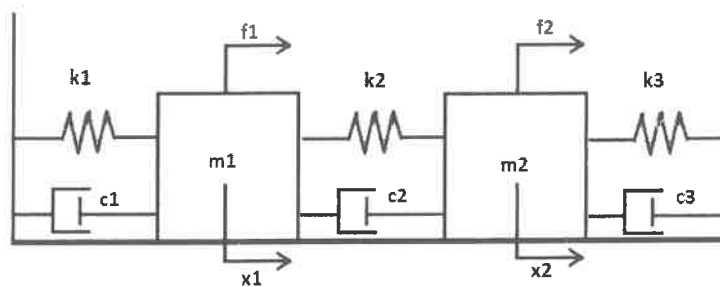
$$x_2 = 10x_1 \quad \frac{dx_1}{dt} + x_1 = u \quad \frac{dy}{dt} + 2y = x_2$$

Draw a block diagram for this control system, identifying the input and output variable of each sub-system.

- Q.5(A) Write differential equations for the following electrical system: 5
- LO-U2-2

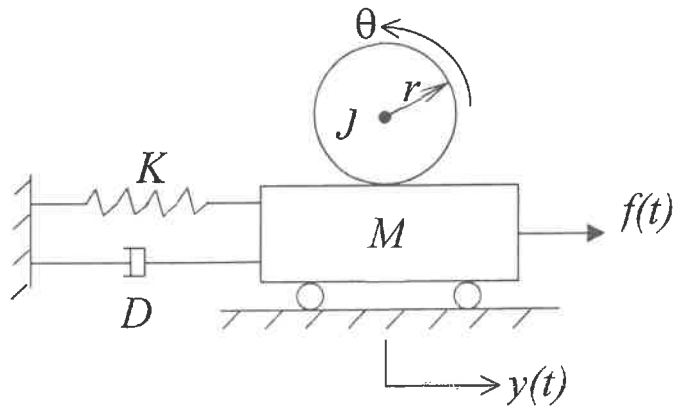


- Q.5(B) Write differential equations for the following mechanical system: 5
- LO-U2-2



- Q6(A) As shown in the figure below, a block with mass M is attached to a spring K and damper D , and is supported on a frictionless plane. A wheel (of radius r and moment of inertia J) rotates about its stationary axis while rolling over the block. 5
- LO-U2-2

The block is subjected to an external force $f(t)$, resulting in a displacement $y(t)$. Assuming the following parameter values $M=1/2$, $J=2$, $r=2$, $D=3$, $K=2$, write differential equations for this system.



- Q6(B) The figure below shows the steady-state Torque-Speed curve for a DC motor available in the market, for $V_{in} = 5V$. Assume the required torque, when Speed = 4 rad/s, is at least 0.2Nm. 5
- LO-U2-3
- Is this DC motor suitable in this case? Justify your answer.
 - Assuming a Speed = 5 rad/s, determine the mechanical power delivered by this DC motor.

