Ex/PG/ProdE/T/113A/2024

M.E. PRODUCTION ENGINEERING
FIRST YEAR
FIRST SEMESTER EXAM 2024
AUTOMATION OF PRODUCTION SYSTEMS

Time: Three hours Full Marks 100

Answer any FIVE questions
All parts of a question (a, b etc.) must be answered at one place.

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1. Define automation and mention the different technologies used in automation. What are the advantages of automation? Classify automated production systems and explain them.

6+6+8

2.(a) Derive the limiting conditions for which part leaves track incase of vibratory conveying.

(b) A standard vibratory bowl feeder has three leaf springs inclined at 80 degrees to the horizontal. These springs are equally spaced around a circle of 225 mm radius and support a bowl that is 600 mm in diameter.
(i)Determine the effective vibration angle for the horizontal upper part of the bowl track.
(ii) If the peak-to-peak amplitude of vibration in the line of vibration at the bowl wall is 0.25 mm and the frequency is 60 Hz, determine whether forward conveying will occur and whether this will be by both forward and backward sliding or by forward sliding only. Assume that the coefficient of friction between part and track is 0.5.

10+10

3.(a) With the help of net sketch describe the orienting mechanism for cup and U- shaped parts in vibratory bowl feeder.

12

(b) With the help of net sketch describe an active orienting device that can be used for orientation of rectangular blocks in vibratory bowl feeder.

8

4.(a) Explain different types of feed tracks used in automatic assembly.

(b) Explain different types of ratchet escapements and drum escapements with neat sketches.

4+16

5.(a) Obtain the transfer function $E_0(s)/ E_i(s)$ of the op-amp circuit shown in Fig.6(a) and show that this can be used as a PI controller. Find also the proportional and integral gain of the controller.

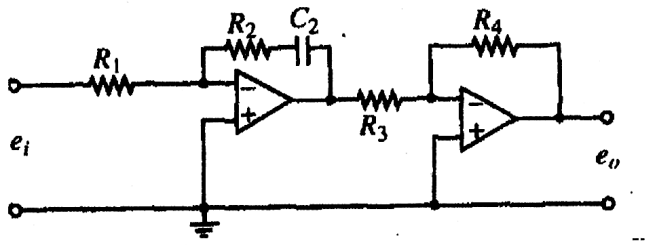

Fig.6(a)

(b) Draw a schematic diagram of a positional servo mechanism using d.c. servomotor, and obtain the closed-loop transfer function of the system, assuming the input and output shaft positions as input and output of the system respectively.

6+14

6. Find out the unit step response of a second order system for different values of damping ratio.

20

7.(a) What do you mean by transient response and steady state response of a system? What is steady state error?

(b) Obtain the transfer function of an LCR circuit. Assume supply voltage and current are the input and output of the system.

(b) A permanent magnet d.c. motor is mounted as the axial drive of a point to point NC machine and drives the leadscrew through a gear ratio (speed of the leadscrew to speed of the motor shift) of 2:1. The machine table mass is 800 kg and the leadscrew pitch is 10 mm. Assume friction and combined moment of inertia of the leadscrew and gear train are negligible. The following numerical values are given for the motor.

K_b=back e.m.f. constant=0.824 *V. Sec/rad*

K_t = torque constant = 0.824 *Nm/A*

R_a = armature resistance = 0.41 *ohm*

J_m = motor shaft inertia =2.15 x 10^{-2} *kg* m^2

i) Calculate time constant of the machine drive unit.

ii) Determine the torque required to accelerate the table during t=0.15 sec to a speed of V=150 mm/s. Assume a constant acceleration rate.

iii) Calculate the steady-state speed for an 85 V input.

5+5+10