Ex/PG/PROD E/T/113A/33/2017

MASTER OF PRODUCTION ENGG EXAMINATION 2017
(1st Year-1st Semester)

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

---

1. What is CIM? Explain different element of CIM system with the help of suitable diagram. Differentiate between automation and CIM.

4+10+6

2. (a) Derive the limiting conditions for which part leaves track in case 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. What is the function of an orienting device? What are the differences between in-bowl and out-of-bowl tooling? With the help of neat sketch describe the orienting mechanism for washer and cup-shaped parts in vibratory bowl feeder.

4+16

4. (a) Discuss different types of feed track used for delivering parts to workhead.
(b) Give one example of simple escapement cum part placing mechanism with figure.
(c) Discuss ratchet escapement, slide escapement and gate escapement with neat sketches.

4+4+12

5. (a) What do you mean by transfer function and block diagram of a system? Find Out the closed-loop transfer function of a closed-loop control system from its feed forward and feedback transfer function
(b) The closed loop transfer function of a second order system is given by

$$\frac{C(S)}{R(S)} = \frac{w_n^2}{s^2 + 2\lambda w_n s + w_n^2}$$

Where, w_n = undamped natural frequency of the system
λ = damping ratio of the system.
Find out the unit step response when the system is critically damped.

8+12

6. (a) What are the advantages of PID control over proportional control?
(b) Draw an op-amp controller circuit that may be used as PID controller and find out the transfer function of the controller and also determine the proportional, integral and derivative gain of the controller.

5+15

7.(a) What do you mean by transient response and steady state response of a system? What is steady state error?
(b) Consider an electrical circuit consisting of a $1M\Omega$ resistance in series with a $2\mu F$ capacitance. Determine how the voltage across the capacitor will vary with time (also show the response curve) when,
i) at a time t=0 the circuit is subject to a voltage of $6V$.
ii) at a time t=0 the circuit is subject to a ramp voltage of $4t$ volt, i.e., the voltage increases uniformly at the rate of $4V$ every 1 sec.
(c) 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.