

PIET's COLLEGE OF ENGINEERING, PUNE
(An Autonomous Institute of Government of Maharashtra)

End Semester Examination Nov-Dec 2011
(PE-5101) Advanced Machine Tool Design

Programme: F.Y. M .Tech (Production)

Year: 2011-12
Duration: 3 hrs
Date: 27/11/11

Semester I
Max. Marks: 50

Instructions:

1. Answer any five questions.
2. Figures to right indicate full marks
3. Draw neat figures wherever required
4. Assume suitable data if required.

Q.1 In CNC machine an antifriction ball guideways are used to reduce frictional resistance of sliding movement. The slide has to support total load of 4000N. The effective number of load sharing balls is 16. If the ball diameter is 7mm, calculate the maximum specific pressure on each ball. The Poisson's ratios for the material used for ball and guideways are 0.35 and 0.32 respectively and the modulus of elasticity for both the materials is $21 \times 10^6 \text{ N/cm}^2$.

Explain the effects on the functioning of slide, if in place of antifriction ball guideways,

- (a) hydrodynamic lubrication is used
- (b) turcite-B material is used.

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Q.2 Explain the hydrostatic lubrication and hydrodynamic lubrication with respect to their applications to machinetool slides

A slide slides along a straight and flat guideways under hydrodynamic lubricating conditions. The antislip lubricating oil with polar additives, has coefficient of kinetic viscosity 0.007 kg sec/m^2 . The minimum film thickness arising from micro surface errors, under hydrodynamic conditions is 0.01 mm. If maximum sliding velocity of slide table is limited to 3m/min, find out the dimensions of the length and breadth of the slide table. The maximum load on the slide is 7500N. The intensity of pressure on guide is limited to 5 N/cm^2

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- Q.3**
- (a) What is static and dynamic rigidity of machinetools?
 - (b) Explain the response of dynamic rigidity with respect to variation in frequency of excitation, when frequency of excitation is (a) less than, (b) greater than and (c) equal to natural frequency
 - (c) What are the experimental methods to determine static rigidity of machine tool?

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- Q.4 (a) What is stickslip? Explain its effects and the methods to minimise the effects of stickslip? 10
- (b) Explain clearly the stability and instability of machine tools.
- (c) Explain the importance of stepless drive in machine tools. How friction drives are made stepless speed drives? What are the limitations of stepless speed friction drives? 10
- Q.5 (a) Explain the considerations for selecting the speeds of intermediate spindle of three spindle shaft gear box.
- (b) A machinetool is required to have six spindle speeds, ranging from maximum speed of 1100 rpm to minimum speed of 120 rpm Draw the speed ray diagram, structural diagram and layout of the three spindle gearbox, showing the positions of gears with number gear teeth.
- The power is supplied by AC induction motor, running at 1480 rpm. which drives the gearbox, through belt and pullay. The diameter of small pulley 25 mm., State whether the output speeds are within the permissible limits. 10
- Q.6 (a) Explain the functioning of photoelectric transducers, used for measurement of linear and angular displacements
- (b) Explain the functioning and working principle of synchro position transducer and linear inductosyn, used in feedback servo system.
- (c) Discuss the open loop and closed loop systems with their merits and deimerits 10
- Q.7 (a) Explain the concept of flexible manufacturing system. State the advantages and limitations of flexible manufacturing system.
- (b) What is adaptive control? Explain the need of adaptive control
- (c) Explain the effects of manufacturing automation on (i) cost of production and (ii) quality of production

College of Engineering, Pune – 5.
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END SEMESTER EXAMINATION

Robotics and Manufacturing Automation (PE 5103)

Programme : M. Tech. (Production)
Duration : 3 Hrs.
Max. Marks : 100

Date : 25/11/2011
Year : 2011 – 12
Semester : I

Instructions:

1. All questions are compulsory.
2. Figures to the right indicate full marks.
3. Draw neat self-explanatory sketches wherever required.
4. Use of pocket calculators is allowed.
5. Assume suitable data, if necessary.

Q.1 a) What is automation? Does part symmetry help or hinder automation? Explain. (4)

b) Both the rotating base hopper and centrifugal hopper feed cylindrical parts. What is the difference? (4)

OR

b) Explain Escapement and placement devices. (4)

c) A particular industrial robot gripper can pick up parts within the following dimensional specification: 50 ± 0.010 mm. The process standard deviation for this dimension is five thousandths. Is the process ready for this industrial robotics application? If the piece part dimension mean is exactly 50 mm, and the variation in the dimension is normally distributed, what percent of the piece parts will the robot be unable to pick up? (4)

Areas of Probability Density of the Normally Distributed Random Variable as below:

Region	Area(%)
$\mu \pm \sigma$	68.26
$\mu \pm 2\sigma$	95.44
$\mu \pm 3\sigma$	99.74
$\mu \pm 4\sigma$	99.994
$\mu \pm 5\sigma$	99.99994
$\mu \pm 6\sigma$	99.9999998

d) Explain role of PLC's in automation? How do they compare with PCS? (4)

Q.2 a) How useful are vacuum grippers in robot application? Where do such grippers find application. (4)

In a robotic system a vacuum gripper is to lift a weight of 100 kg with the help of a single suction cup having a diameter of 150 mm. Determine the negative pressure required to lift the weight. Use factor of safety of 1.5.

- b) Illustrate a robot gripper which is: (4)
- i) Cam Operated
 - ii) Screw Operated
 - iii) Lever Operated
 - iv) Gear Operated

OR

- b) Recommend type of gripper appropriate for following applications: (4)
- i) Hot-metal pouring
 - ii) Grasping of Carton box
 - iii) Lifting of sheet metal
 - iv) Handling of Glass sheets

- c) For a pick and place type of Robot system a finished component of 20 kg weight is to be lifted by gripper using two opposing fingers. The coefficient of friction between the fingers and the component surface is estimated to be 0.3. The orientation of the gripper will be such that the weight of the component will be applied in a direction parallel to the contacting finger surfaces. A fast work cycle is anticipated so that the 'g' factor to be used in force calculation should be 3. Calculate the required gripper force for the given specifications. (8)

- Q.3 a) A servomotor used to actuate one of the joints of the cylindrical robot has a torque constant of 30 N-m/A and a voltage constant of 15×10^{-3} V/rpm. The armature resistance is 30Ω . When the joint is stationary the voltage applied is 60V. Determine: (4)
- a) The torque exerted by the motor on the joint when the robot is stationary.
 - b) Determine the back e.m.f. and the torque when the motor is running at 500 rpm and 1000 rpm.

- b) Explain performance and selection criteria of electric actuators in robotics? (6)

OR

- b) Select the most suitable axis-drive system (hydraulic or pneumatic or electric) for each of the following robotic systems; justify your answer in each case. (6)
- i) A small pick place type robot system for fast operations where accuracy is not important.
 - ii) A robot system with large pay-load capacity high speed of response and working in an explosive environment.
 - iii) A medium pay-load capacity robot, limited floor space and in need of clean environment with less accuracy work style.

- c) A stepper motor has four poles on the stator and five slot like poles on the either side of the rotor. What is the smallest step that can be made? (4)

- d) Explain with a neat sketch a hydraulic circuit for a non-servo robot arm? (4)

- Q.4 a) Discuss the method of obstacle avoidance in the path of robot using Lee's algorithm. (4)

- b) What is meant by "blending time"? (6)

If α is the angular acceleration during the blending time show that

$$\alpha \geq 4 \left(\frac{\theta_f - \theta_0}{T^2} \right)$$

where θ_f and θ_0 are the final and initial joint angle respectively and T is the cycle time.

OR

- b) Describe DH Kinematic transformation procedure. (6)

- c) A simple robot has the link parameter table as follows: (8)

i	α_{i-1}	a_{i-1}	d_i	θ_i
1	0	0	0	60
2	90	2	0	0
3	0	0	3	60

Determine the origin of the gripper w.r.t. the base frame indicating all the intermediate steps.

- Q.5 a) What is edge detection? Explain the procedure. (4)

- b) Write a program in VAL for performing palletization operation for filling the bottles in a cartoon box of an array of 3x3. (4)

OR

- b) Describe briefly lead-through programming method. (4)

- c) A 10x8 image has intensity value as given below: (8)

i) Construct a histogram and obtain the threshold value.

ii) Convert the picture into black and white image after smoothening binary image & identify the object.

88	81	87	89	82	75	79	90
77	70	82	85	78	74	88	89
89	67	50	56	42	50	67	98
92	72	55	66	68	55	72	93
81	54	25	9	20	29	54	88
69	84	8	29	22	18	84	94
89	72	50	56	42	50	72	98
68	62	50	56	42	50	62	77
88	81	87	89	82	75	79	90
89	56	50	56	42	50	88	98

- Q.6 a) Explain with a neat sketch the method of tactile array type sensor mounted on a mechanical gripper and a closed loop control system to provide just sufficient amount of gripper pressure to hold the object (6)

- b) With a neat sketch explain the working of photoelectric sensor. (4)

OR

- b) Explain ultrasonic proximity sensor. (4)

- c) Explain how sensors are grouped on the basis of (6)

- i) Function Performed
- ii) Location and type of detection
- iii) Physical Activation

End Semester Examination

IE5118- Microcontroller Applications

Semester -I

Year: F.Y. M-Tech.
Academic Year: 2011 -12
Duration: 03 Hours

Branch: Production

Max. Marks: 50

Instructions to candidates:

1. Neat diagram must be drawn wherever necessary
 2. Assume suitable data if necessary
 3. Figures to the right indicate full marks
 4. Use of only non programmable calculator is allowed
 5. Start answers of each question on new page.
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Q.1 State true or false (with justification)

- 1 MCS-51 architecture can access maximum 64Kbytes of program memory
- 2 To interface external devices to PORT 0, it is mandatory to connect external pull-ups
- 3 Stepper motors can be directly driven by microcontroller ports
- 4 For 8051 based systems, 11.0592MHz crystal is more appropriate than 12MHz crystal, for serial communication using on-chip UART
- 5 We can connected maximum 1024 devices to I²C based master node

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Q.2

- A Draw flow chart and logical diagram, to describe the behavior of a water pump controller. The controller is to monitor the level of water periodically and switch on the pump (to evacuate the water) when the level reaches a high level mark and to switch off the running pump when the level reaches lower level. Use appropriate input and output signals.
- B Write a Program to generate a square wave of 20ms ON time and 10ms OFF time on P1⁰ pin and inverted O/P of P1⁰ on P1¹ pin continuously. Assume crystal frequency 12 MHz.

06

04

Q.3

Solve any two

- A Explain in briefly any two applications of microcontroller in Mechatronics systems 05
- B With a neat sketch explain the interfacing of single-phase unipolar stepper motor to 8051 based system. Write a programming steps to drive motor in clock wise direction 05
- C Draw interfacing diagram to show interfacing of
1. PC with Microcontroller
 2. Load cell with microcontroller

05

Q.4

Solve any two

- A A temperature sensor LM35 (whose o/p is $10\text{mv}/^\circ\text{C}$), is connected to channel 1 of ADC0808, the specifications of the system are as:
After signal conditioning, temp. Sensor LM35 whose
O/P: 1V for 25 degree centigrade &
O/P: 5V for 90 degree centigrade
Draw the detail interfacing diagram and write a program to display the temperature on 7-segmnet LED's. 05
- B Explain in details Special Function Registers (SFR's) associated with on-chip interrupts 05
- C Explain in details factors to be considered while selecting a microcontrollers for a particular applications 05

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PIET's COLLEGE OF ENGINEERING, PUNE
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Test: End Semester Exam

(PE-5164) Reliability Engineering

Programme: M .Tech (Production -Mfg. Engg & Automation)

Year: 2011-12

Duration: 3 hrs

Date: 23/11/11

Semester I

Max. Marks: 530

Instructions:

1. All questions are compulsory.
2. Assume suitable data if required.
3. Figures to right indicate full marks.
4. Draw neat figures where ever required.

- Q.1 a) Discuss briefly the use of Ferrography for monitoring the schedule of predictive preventive maintenance. (5)
- b) What is meant by heated Ferrography and how is it done ? explain your answers through wear particles concentration, severity index and distinguishing colors for the elements. (5)
- Q.2 a) Describe the non-parametric evaluation of reliability using K statistics, when the sample size is 20, with no failure occurring, but maximum & minimum limits are provided for the output yield. (5)
- b) A vibration monitoring system consists of six sub-systems, all connected in series. The predicted reliabilities as obtained from an analysis are $R_1 = 0.993$, $R_2 = 0.996$, $R_3 = 0.998$, $R_4 = 0.997$, $R_5 = 0.987$, $R_6 = 0.989$. Calculate the system reliability. If it is desired to increase the reliability by 3%, determine the percentage by which the reliability of each sub-system should be increased. Assume an exponential model for each subsystem. (4)
- Q.3 a) If in a system we need at least one out of 3 units to operate for the successful working of the system, then prove that the system reliability can be written as: (4)
- $$R_s(t) = 3 e^{-\lambda t} - 3 e^{-2\lambda t} + e^{-3\lambda t}$$
- Where λ -constant failure and t-mission time. (4)
- b) Find out the failure rates of the components so that the system reliability becomes 0.96 using AGREE method, the data being given below. (4)

Sr. No. Components	No. of Component Modules (n_i)	Optg Time (t_i)	Prob. of system due to failure of subsystem (w_i)
1	4	12	0.10
2	8	4	0.20
3	6	10	0.25
4	13	15	0.25
5	10	10	0.20

State any assumptions made.

- Q.4 Write short notes on: (Any three) (8)
- i) Matrix method of estimating reliability of the system.
 - ii) Quantum debris analysis for finding out trend of failure
 - iii) Genetic Breeding of Design.
 - iv) Tie set or Cut set theory of System Reliability.
 - v) Criticality Analysis through RPN in FMECA.
- Q.5 a) Explain the procedure for assessing the life cycle cost of an equipment, Discuss detailing individual component of costs. (4)
- b) Discuss, in reference to the Bath-tub curve, the various phases of the assets life, and explain what type of probability distribution is suitable to fit in here. (4)
- Q.6 a) Explain also why in the random failure region the hazard rate remain constant. (4)
- b) What are "Loading Roughness" and "Intrinsic Reliability"? (4)
- b) Explain briefly the various methods of assessing reliability of a component through accelerated tests. (4)