B.Tech.

Fifth Semester Examination

Manufacturing Technology-II (ME-309-F)

Short Answer Type Questions.

Q. 1. (a) Define tool life?

Ans. Excessive cutting speed cause a rapid failure of the cutting edge of the tool, thus tool can be declared to have had a short life.

The period of tool during working to before damaging known as tool life.

Q. 1. (b) Differentiate between orthogonal cutting and oblique cutting?

Ans. Orthogonal Cutting : In this type the major cutting edge of the tool is presented to the workpiece perpendicular to the direction of feed motion.

Oblique Cutting : In oblique cutting the major edge of the cutting tool is presented to the workpiece at an angle which is not normal to the direction of feed motion.

Q. 1. (c) What is the purpose of cutting fluid?

Ans. The main purpose of cutting fluid is to reduce the friction and heat during cutting. Thus due to this increase the tool life.

Q. 1. (d) Gives the advantages of ultrasonic machining?

Ans. Advantages :

(i) High accuracy and good finish are easily attainable.

(ii) Equipment is safe to operate.

(iii) Little or no heat generation during machining.

(iv) Low cost of metal removal.

Q. 1. (e) Differentiate between jigs and fixture?

Ans. Jig : A jig is a device which is holds and positions the work, locate or guides the tool relative to the job.

Fixture : It is defined as the work holding device which only holds and positions the work but does not grid.

Q. 1. (f) Give the advantages of group technology?

Ans.

(i) In group all similar component arrange in the family.

(ii) The efficiency is achieved by arranging the production equipment.

(iii) The plant currently uses traditional batch production.

Q. 1. (g) Classification of NC machines?

Ans. NC machine are classified on the basis of :

(i) Based on type of control system :

    (a) Open loop control NC

    (b) Close loop control NC

(ii) Based on the type of motion control :

    (a) Point to point NC

    (b) Straight cut NC

    (c) Contouring NC

Q. 1. (h) Define flexibility?

Ans. Flexibility : It is an attribute that applies to both manual and automatic system to develop the concept of flexibility is an automated manufacturing system.

Q. 1. (i) What is milling?

Ans. Milling : In milling machine the metal is cut by means of rotating cutters having multiple cutting-edge. For cutting operation, the workpiece fed against the rotary cutter.

Q. 1. (j) Define the various type of chips in cutting?

Ans. In a metal cutting operation is carried out in machine shop. Chip are separated from workpiece to impart the required shape and size of workpiece since there are four types are chip is generated :

    (i) Segmental chips

    (ii) Continuous chips

    (iii) Continuous chips with built-up edge.

    (iv) Non-homogeneous chip.

Section-A

Long Answer Type Questions.

Q. 2. What do you understand by merchant cutting force circle gives an expression?

. **Ans.** When the chip above the shear plane is considered as a rigid body moving with a constant velocity, the resultant of force acting on it from the rack surface of the tool R and the work surface along the shear plane (R') must be zero.

$$\frac{F}{N} = \mu$$

$$\mu = \tan \lambda$$

$$\lambda = \text{Frictional angle}$$

$$F_N = \text{Normal force}$$

F_S = Shear force

The relationship among the different component, respectively and resultant cutting force can be best understood with the help of diagram known as merchant circle diagrams.

Using figure the relation that can be written as,

$$F_C = F_S \cos\phi + F_N \sin\phi$$

$$F_T = F_N \cos\phi - F_S \sin\phi$$

$$F = F_C \sin\alpha + F_T \sin\alpha$$

$$N = F_C \cos\alpha - F_T \sin\alpha$$

$$F_S = F_C \cos\phi - F_T \sin\phi$$

$$F_N = F_C \sin\phi + F_T \cos\phi$$

Now,

$$R = \frac{F_S}{\cos(\phi + \lambda - \alpha)}$$

$$F_C = R\cos(\lambda - \alpha)$$

$$= \frac{F_S \cos(\lambda - \alpha)}{\cos(\theta + \lambda - \alpha)}$$

$$\tan(\lambda - \alpha) = \frac{F_S}{F_C}$$

$$\tan(\lambda - \alpha) = R\sin(\lambda - \alpha)$$

$$\frac{F_S \sin(\lambda - \alpha)}{\cos(\phi + \lambda - \alpha)}$$

Coefficient of friction

$$\mu = \frac{F}{N}$$

$$= \frac{F_C \sin\alpha + F_T \cos\alpha}{F_C \cos\alpha - F_T \sin\alpha}$$

If τ_S is ultimate shear stress of the work material, then shear force.

$$F_S = \frac{\omega t_1 \tau_S}{\sin\phi} \qquad \text{...(1)}$$

t_1 = Uncut thickness

$$F_C = \frac{F_S \cos(\lambda - \alpha)}{\cos(\phi + \lambda - \alpha)}$$

Using equation (1) in the above equation,

$$F_C = Wt_1\tau_s \cos(\lambda - \alpha)\left(\frac{1}{\sin\phi\cos(\phi + \lambda - \alpha)}\right)$$

Power consumption during machining

$$W = F_C.V = VWt_1\tau_s \cos(\lambda - \alpha)\left[\frac{1}{\sin\phi\cos\theta(\phi + \lambda - \alpha)}\right]$$

Assume τ_S and λ is not varies.

$$W(\phi) = \frac{\text{Const.}}{\sin\phi\cos(\phi + \lambda - \alpha)}$$

Differentiate the denominator.

$$\cos\phi\cos(\phi + \lambda - \alpha) - \sin\phi\sin(\phi + \lambda - \alpha) = 0$$

$$\cos(2\phi + \lambda - \alpha) = 0$$

$$\boxed{2\phi + \lambda - \alpha = \frac{\pi}{2}}$$

Where, $\qquad\qquad \lambda = \tan^{-1}\mu$

Then, $\qquad\qquad F_C = \dfrac{2Wt_1\tau_S \cos(\lambda - \alpha)}{1 - \sin(\lambda - \alpha)}$

The normal stress acting on shear plane.

$$\sigma = \frac{F_N}{Wt_1 / \sin\phi}$$

From Diagram, $\qquad \dfrac{F_N}{F_S} = \tan(\phi + \lambda - \alpha)$

$$\boxed{F_N = F_S \tan(\phi + \lambda - \alpha)} \qquad \textbf{Ans.}$$

Q. 3. Define various type of cutting tool material? Gives the properties of cutting tool material?

Ans. There are many types of cutting tool material are used listed below :

(i)	Carbon-tool steel.	(ii)	High-speed steel.
(iii)	Cast cobalt base alloy.	(iv)	Cemented carbides
(v)	Diamonds tools.		

(i) Carbon Tool Steel : These are plane carbon steel with 0.6 to 1.5% carbon, very little quantities of Mn, Si, Cr or V are added to increase the hardness and refine grain size. Low carbon varieties posses good toughness and shock resistant where high carbon varieties are abrasion resistant with any ability to maintain a sharp cutting edge.

(ii) High Speed Steel : These are basically high carbon steel with significant quantities of Tungsten molybdenum, Cr, V and cobalt. These alloying element improve hardness hardenability, toughness and wear

resistant. They also improve high temperature properties, these steel retain the keenness of the cutting edge and hardness upto 600°C there by permitting much higher cutting speed.

Basically two type of high speed steel. T type for tungsten predominant and M type for molybdenum predominate alloy. According to AISI designation mb high speed steel slightly tougher at same level of hardness as compare to tungsten variety.

(iii) Cast Cobalt Base Alloy : It is combination of tungsten, cremium and cobalt which form an alloy with high red hardness, wear resistance and toughness. This material is made by melting the element together and then cast is moulds, hence they are known as cast alloys. Four primary element in this alloy is cobalt, chromium, tungsten and carbon other element such as V, Mo, tantalum etc. are added to improve specific properties. A part of chromium and tungsten can be substituted by molybdenum, tantalum and columbium to form carbides.

(iv) Cemented Carbides : These are carbides of tungsten, titanium and tantalum with certain amount of cobalt. These carbides are produced through the powder metallurgy route.

Classification of Cemented Carbides :

(a) Straight tungsten carbide cobalt grade.

(b) Alloy tungsten carbide grade.

(v) Diamond Tool : It is extensively used for truing the grinding wheel and to a lesser extent for fine finishing of metal. Diamond is the one of the hardest material with excellent abrasion resistant. Its thermal conductivity and melting point are high.
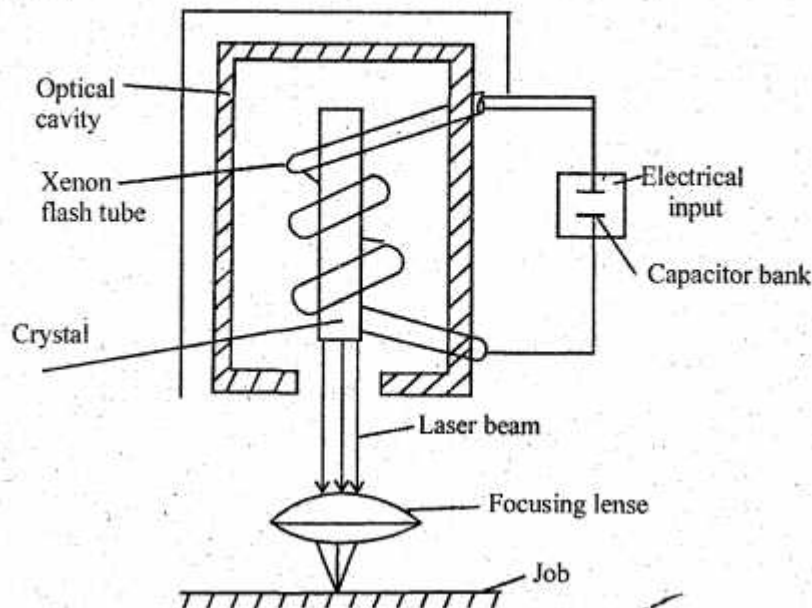
Properties :

(i) Hot Hardness : It is ability of material to retain its hardness at high temperature.

(ii) Wear Resistant : It enables the cutting tool to retain its shape and cutting efficiency.

Section-B

Q. 4. Define the principle and application of laser beam machining? Gives advantages of LBM? Also give the advantages of AJM?

Ans. Principle :

The word 'LASER' stand for "Light complication using simulated emission of radiation." Laser provides intense and unidirectional beam of light. This light coherent in nature. The mechanism by which a laser beam remove material form the surface being worked involved combination of melting and evaporation process. However, with some material the mechanism is purely one of evaporation.

(i) It required a man made ruby crystal. Ruby is aluminium oxide.

(ii) Around the crystal a flash tube are placed which contains inert gas.

(iii) Flash tube converted electrical energy into light energy.

(iv) A capacitor bank which is store the electrical energy.

All working are clearly understood by above fig.

Application :

(i) Laser is a high energy light beam that can both weld and cut the metal.

(ii) To connecting lead for small electronic component and in integrated.

Advantage :

(i) No mechanical contact between tool and work.

(ii) Beam can be projected through a transparent window.

(iii) Laser can be used with materials sensitive to heat sock such as ceramics.

(iv) Workpiece is not subjected to large mechanical force.

Advantages of Abrasive Jet Machining?

(a) Ability to cut intricate hole in material in any hardness.

(b) Ability to cut fragile, brittle or heat sensitive material without damage.

(c) Absence of mechanical contact between tool and work.

(d) Low capital cost.

Q. 5. Define the principle and operation of electro-chemical machining also gives the advantages?

Ans. Electro-Chemical Machining : This method removes metal without the use of mechanical or thermal energy. Electric energy is combined with a chemical to form a reaction of reverse plating. Direct current at relatively high amparage and low voltage continuously passed between the anodic workpiece and cathodic tool.
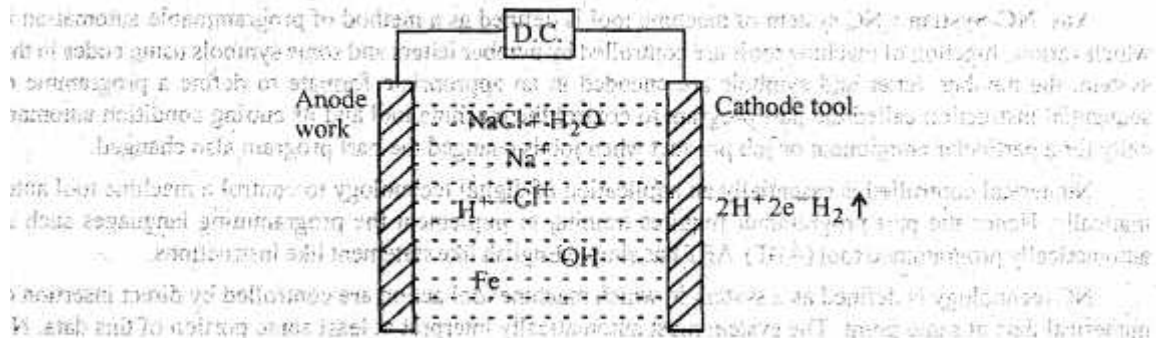
This Method Offers :

(i) High metal removal rates for hard alloy.

(ii) Rapid metal removal rates when matching complex three dimensional surface.

(iii) Freedom from metallurgical damage.

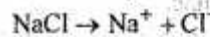(iv) Accuracy and economy through the inherent characteristics of the process.

Principle of Operation :

(i) A cathode tool prepared with an approximate mirror image of the configuration to be machined into the workpiece.

(ii) A workpiece and means to hold and locate it in close proximity to the tool.

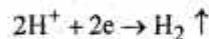(iii) A means of supplying the gap between tool and workpiece with pressurized flowing conductive liquid.

(iv) A carefully controlled source of dc electrical power of sufficient capacity to maintain a current density between tool and workpiece.
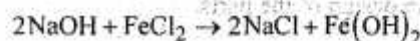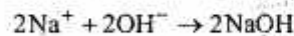

When current is switched an the electrolyte $(NaCl + H_2O)$ get ionised according to following relation :

$$NaCl \rightarrow Na^+ + Cl^-$$

$$H_2O \rightarrow H^+ + OH^-$$

As hydrogen ion reach the cathode, the combine with free electrons,

$$2H^+ + 2e \rightarrow H_2 \uparrow$$

Assume that pure iron, is being machined by this process

$$2Na^+ + 2OH^- \rightarrow 2NaOH$$

$$Fe^{2+} + 2Cl^- \rightarrow FeCl_2$$

$$2NaOH + FeCl_2 \rightarrow 2NaCl + Fe(OH)_2$$

Removal of material from the workpiece during ECM can be calculated from Faraday law of electrolysis :

$$W = \frac{1}{96500} \frac{NIt}{n} \times h$$

Application :

(i) This process is particularly suitable for small deep hole.

Penetration rates from 0.75 to 12.5 m per min or more are possible.

(ii) Aircraft and acrospace component are produced frequently by this method.

Advantages :

(i) Ability to machine economically the complex shape workpiece.

(ii) Machining ability is independent of mechanical properties of work material.

(iii) Production of stress free surface.

Section-C

Q. 6. What do you understand by NC system? Gives the advantages of NC system?

Ans. NC-System : NC system of machine tool is defined as a method of programmable automation in which various function of machine tools are controlled by number letters and some symbols using codes in this system, the number, letter and symbols are encoded in an appropriate formate to define a programme of sequential instruction called the part program to control the machine tool and its cutting condition automatically for a particular component or job product when job is changed the part program also changed.

Numerical controlled is essentially an application of digital technology to control a machine tool automatically. Hence the part programmer requires training to implement the programming languages such as automatically programmed tool (APT). APT has simple English like statement like instructions.

NC technology is defined as a system in which machine tool action are controlled by direct insertion of numerical data at same point. The system must automatically interpret at least some portion of this data. NC machine responds to a series of coded instruction by actuating various drives to the required extent, in a desired sequence of operation needed for part to be manufactured. The direct and indirect measurement of linear displacement of machine tool work of NC machine.

NC machine operator need not be a highly skilled worker now a days NC machine are utilized to produce simple as well as complex shape of product.

These machine are used for non-machining operation as well as drafting cutting of sheet metal part, spot welding, tube bending etc.

It is found suitable under :

(a) Component are made in small batches for machining.

(b) Component has complex shapes for machining.

(c) More metal needs to be removed from the part.

(d) Designing fixtures and other setup are numerous and costly.

(e) There is a possibility of change in design of the parts.

Advantages :

(i) Modern NC machine impart greater accuracy.

(ii) Improved product quality can be achieved using NC technology.

(iii) Lower tooling cost due to emission of expensive jigs and fixtures.

(iv) Machine operator errors are reduced.

(v) Helps to reduce scraps.

(vi) Rework of the job is avoided.

Q. 7. What do you understand by group technology? Define FMS?

Ans. Group Technology : It is a manufacturing philosophy in which similar parts are identified and grouped together to take advantage of their similarities in design and production.

Similar parts are arranged in two part familiar.

Where each part family process similar design and/or manufacturing characteristic.

Example : A plant producing 12000 different parts number may be able to group the vast majority of these part in to 30–40 distinct families. It is reasonable to believe that the processing of each member of a given family

is similar and this should result in manufacturing efficiency.

The efficiency are generally achieved by arranging the production equipment into machine group or cells to facilities work blow.

Grouping the production equipment in to machine cells where each cell specilizes in the production of a part family is called cellular manufacturing.

Group technology is most appropriatly bach production and a process type layout and this result in much material handling effort, high in process inventory and long manufacturing least times.

FMS : The name FMS indicate that the system is capable of processing a variety of different type of work part simultaneously under the control of main from computer.
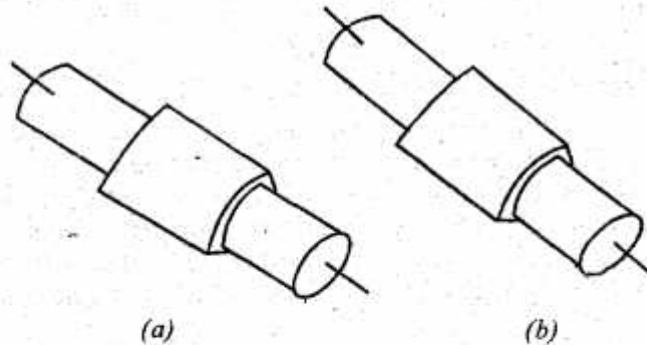
This concept includes flexible, automation, group technology, CNC, MIG tool, DNC machine etc.

Section-D

Q. 8. What do you understand by group and families technology and also defined coding classification?

Ans. Parts can be Grouped Into Part Family : This is necessary condition to each machine cell is design to produce a given part family or limited collection of part families so it must be possible to group part made in the plant families. However it would be usual to find a volume production plant in which parts could not be grouped into part families.

Part Families : A part families is a collection of part that are similar either because of geometry shop and size are becomes similar processing steps are required in their manufacturing the part with in a family are different, but their similarities are close enough to merit their incursion as member of the part families.

(a)   (b)

Two part identical shape and size as shown in fig. but different manufacturing requirement (a) 1000,000 PC/yr tolerance = ± 0.010 in, material = 1015 (R. Steel, Nickel plate and (b) 100 PC/Yr tolerance = ± 0.001 in material = 18–8 stainless steel.

Coding : The need of classification of coding system for identification of retrieval of similar design has been well emphasized in an earlier discussion, this would lead to variety, reduction, standarization and design rationalization sequence and method of manufacturing would enable the grouping of part for process planning & production planning.
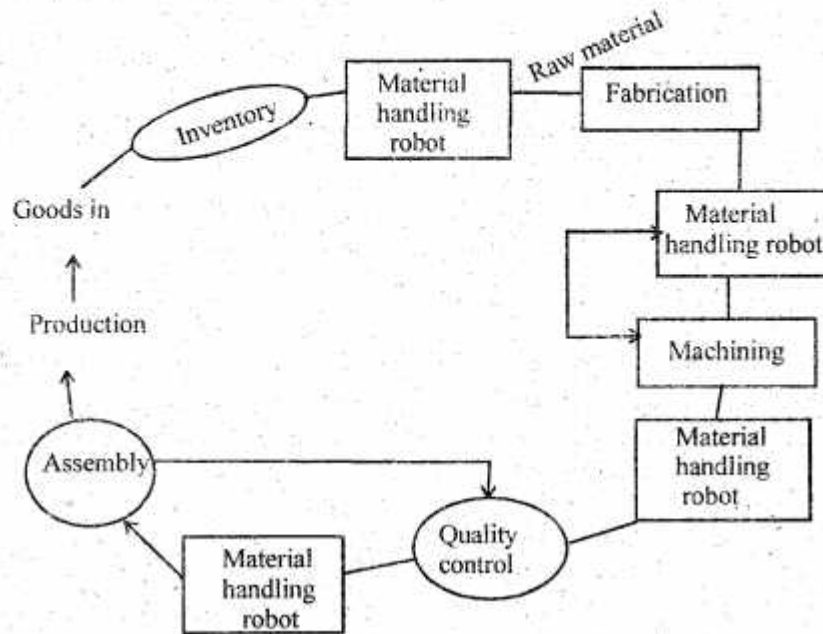
Code : Kind of workpiece ← Rotational → ← Non-rotational → Number of hole coin axles

Overall dimension.

$D/M = 0-40$ mm

L/D

Feature : O-smooth, thread in axis, hole not in axis, splines/grooves taper, combination.

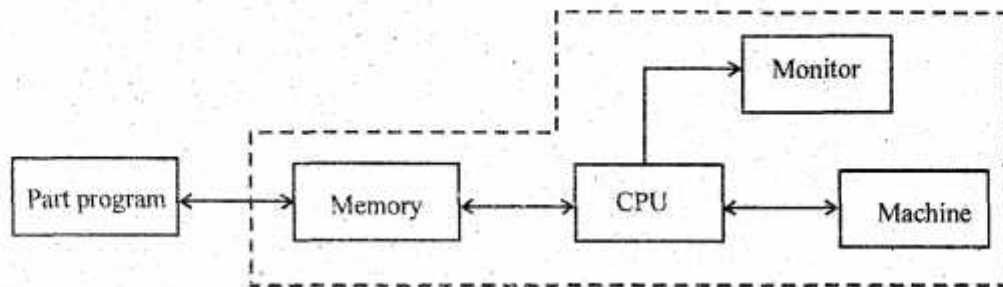**Q. 9. What do you understand by CNC and DNC machine explain?**

Ans. CNC Machine : This type of machine generally use a tape reader for storing and inputting the program into the memory of the NC machine tool. Due to unreliability the tape reader as well as the low speed of operation, NC machine effort were being applied for searching for a suitable alternative. Instead the part program is transmitted to the MCU directly from the computer. NC machine encountering the such difficulties are overcome using CNC machine. The change in trend from hardware to software has increased productivity and flexibility in manufacturing. A CNC machine basically a NC machine with a dedicated computer as its integral part.

A CNC machine does not have those limitation which are inherent to a NC machine.

This development became very popular with NC machine user due to various significance application :

(i)   The computer can be used for editing the program.

(ii) Since the computer has large memories there was no limitation in the number of size of program stored.

(iii) Copy program to and from the floppy disc.

(iv) Editing the existing program or create a new program.

(v)   Eliminating the need for paper tate in the old generation of NC machine.

Features of CNC Machine :

DNC Machine : Early NC machine used a tape reader for storing and inputting the program into memory of NC machine tool. Due to unreliability of tape reader as well as low speed of operation NC machine effort were being applied for searching. For suitable alternative several clones of APT languages were introduced in 80's to automatically develop NC code from the geometric model of the component, now one can model, draft, analyse, modify optimize and create the NC code.

Manufacturer a component and simulate the machining operation sitting at a computer workstation. In this system a number of machine were connected and controlled by a single computer. The central computer usually has large capacity and it can be main frame computer which can stores program after processing, send the controlled signal to respective NC machine.

There are silent feature of DNC machine system which are given :

(i) A single computer can be used to operator many machine in the stop floor.

(ii) A number of NC machine can be connected to single computer.

(iii) The DNC computer store all parts program and transfers the programmes to CNC machine in response to request to the operator.

(iv) The concept of internet, internet and extranet has future enlarged the scope of distributed numerical control.

(v) DNC system are generally designed for 4, 8 and 16 CNC machine. However with the wide spread acceptance of local area network concept, the possibility of connecting more CNC machine in a DNC network has become a reality.