



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Important Instructions to examiners:

- 1) The answers should be examined by key words and not as word-to-word as given in the model answer scheme.
- 2) The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.
- 3) The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills).
- 4) While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.
- 5) Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.
- 6) In case of some questions credit may be given by judgement on part of examiner of relevant answer based on candidate's understanding.
- 7) For programming language papers, credit may be given to any other program based on equivalent concept.

Q. 1 A) Attempt any three

a) What is factor of safety? State its importance with respect to machine tool.

FACTOR OF SAFETY

The factor of safety is defined as a ratio of the maximum load carrying capability of the component to the design loading. Type of loads can be static, impact, fatigue, etc. The purpose of using a safety factor is to safeguard the design against unexpectedly high loads, material defects and process defects. It results the probability of failure. This is also called the factor of uncertainty on the part of material, process, design and service performance of a component.

There are a number of factors, which are difficult to evaluate accurately in design analysis like uncertainty in the magnitude and direction of forces acting on the machine tool, variation in the properties of materials, variation in the dimensions of the machine tool components due to changing environment etc. Such factors lead to catastrophic or premature failure of the machine tool components. Therefore it is necessary to consider a factor which will take care of all such problems while designing any machine tool.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Lower factors of safety are required if high quality and consistency of materials, manufacturing, maintenance and inspection are ensured. Good control or knowledge of the actual loads and environment and highly reliable analysis and/or experimental data is required. For example, in commercial airplane business has extremely rigorous control over airplane structures and systems from fabrication and assembly through inspection and maintenance. The environmental effects and maximum loads that airplanes experience are also well understood. Extensive fatigue and static testing is conducted on components and systems. The criteria of using particular value of factor of safety as low as 1.3 in aircraft industry to as high as 5 in machine tool design depends on the estimation of uncertainties as well as probability of failure. In some instances like in pressure vessels the factor of safety is mandated by design code and standards. More often the factor of safety is decided by experience of similar designs. In mechanical engineering practice typically factor of safety ranges from 1.3 to 5. Factor of safety is based on number of factors like material strength, nature of load, misuse, complex state of stress, environment, etc.

(02 Marks for Definition 02 Marks for importance.)

b) State any four requirements of machine tool structures.

Machine tool structures must satisfy the following requirements:

1. All important mating surfaces of the structures should be machined with a high degree of accuracy to provide the desired geometrical accuracy.
2. The initial geometrical accuracy of the structures should be maintained during the whole service life of the machine tool.
3. The shapes and sizes of the structures should not only provide safe operation and maintenance of the machine tool but also ensure that working stresses and deformations do not exceed specific limits. It should be noted that the stresses and deformations are due to mechanical as well as thermal loading.

The design features that provide for ease of manufacture, maintenance, etc., are peculiar to each structure and will, therefore, be discussed separately for different structures. However, there are two common features which are fundamental to the satisfactory fulfillment of above requirements for all structures. These are:

1. Proper selection of material.
2. High static and dynamic stiffness.

Any 04 requirements 04 Marks

c) Draw the neat sketch of open & closed type guide way and explain where it is used.



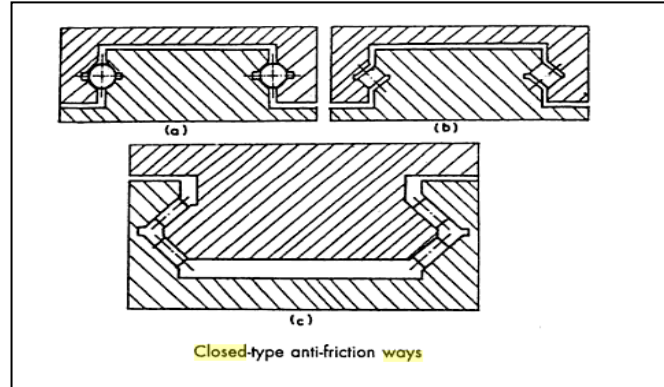
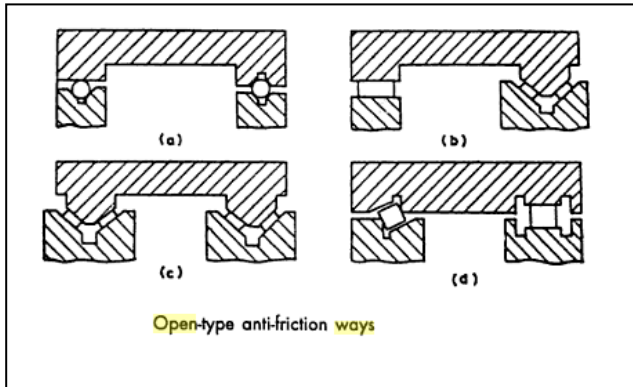
SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Anti-friction guideways employ the same shapes as slideways. These shapes can be obtained by an appropriate surface profile or by changing the profile and location of the rolling elements. Anti-friction ways can be open or closed type. A few examples of open ways are shown in Fig. It may be noted that the V profiles of Fig. c and d have been obtained by different methods. Open-type anti-friction ways are employed only when the dead weight of the moving member constitutes the major load which does not change appreciably during the cutting operation.

Closed-type anti-friction guideways are used when working loads are relatively large and guideways are required to have high stiffness. Higher stiffness is achieved through preloading of rolling members. As a matter of fact horizontal rolling members automatically experience some preloading due to the weight of the moving member.



Application 01 Mark Sketch 03 Marks

d) How machine tool is different from cutting tool?

Cutting Tool	Machine Tool
<ul style="list-style-type: none">• Cutting tool is any tool that is used to remove material from the work piece by means of shear force.	<ul style="list-style-type: none">• Machine tool is an assembly of many machine parts to convert energy from one form to another.
<ul style="list-style-type: none">• Cutting tool is a component of machine tool	<ul style="list-style-type: none">• Machine tool represents itself such as milling, lathe machine.
<ul style="list-style-type: none">• Cutting tools are used for cutting the workpiece.	<ul style="list-style-type: none">• Machine tools employ some sort of tool that does the cutting or shaping.
<ul style="list-style-type: none">• Cutting tool is portable.	<ul style="list-style-type: none">• Machine tool is a non portable power operated.

01 Mark for each point of difference

B) Attempt any one



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

i) State at least four factors considered while selecting a factor of safety. State importance of each of them.

1. Effect of failure Sometimes, the failure of machine element involves only a little inconvenience or loss of time e.g., failure of the ball bearing in gear box. On the other hand in some cases, there is substantial financial loss or danger to the human life e.g., failure of the valve in pressure vessel. The factor of safety is high in applications where failure of machine part may result in serious accidents.

2. Type of load The factor of safety is low when the external force acting on the machine element is static i.e., a load which does not vary in magnitude or direction with respect to time. On the other hand, a higher factor of safety is selected when the machine element is subjected to impact load. This is due to the fact that impact load is suddenly applied to the machine component, usually at high velocities.

3. Degree of accuracy in force analysis When the forces acting on the machine component are precisely determined, a low factor of safety can be selected. On the contrary, a higher factor of safety is necessary when the machine component is subjected to a force whose magnitude or direction is uncertain and unpredictable.

4. Material of component When the component is made of homogeneous ductile material like steel, yield strength is the criterion of failure. Factor of safety is usually small in such cases. On the other hand, cast iron component has non-homogeneous structure and a higher factor of safety based on ultimate tensile strength is chosen.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

5. Reliability of component In certain applications, like continuous process equipment, power stations or defense equipment, high reliability of machine parts is expected. The factor of safety increases with increasing reliability.

6. Cost of component As the factor of safety increases, dimensions of component, material requirement and cost increase. Factor of safety is low for cheap machine parts.

7. Testing of machine element A low factor of safety can be chosen when the machine component can be tested under actual conditions of service and operation. A higher factor of safety is necessary, when it is not possible to test the machine part or where there is deviation between test conditions and actual service conditions.

8. Service conditions When the machine element is likely to operate in corrosive atmosphere or high temperature environment, higher factor of safety is necessary.

9. Quality of manufacture When the quality of manufacture is high, variations in dimensions of machine component are less and a low factor of safety can be selected. Conversely, a higher factor of safety is required to compensate for poor manufacturing quality.

Any four factors 02 marks & Importance of those 04 marks

ii) State the different materials used for machine tool structure. State their specific advantages & disadvantages.

The materials used are :- The commonly used materials are **cast iron and steel**. The cast iron structures were almost exclusively used in machine tools till a decade or so ago, but lately welded steel structures are finding wider applications due to advances in welding technology.

Advantages-

- 1 Steel has higher strength under static and dynamic load so it can take heavy loads.
- 2 Rigidity of steel under tensile, torsional, and bending loads is higher.
- 3 Cast iron has higher inherent damping and skidding properties.
- 4 Cast iron can be used for complex structures..

Disadvantages-



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

1 Steel cannot be used for complex structures.

2 Cast iron cannot be used for heavy loads.

Materials-02 marks, any 02 advantages-02 marks & any 02

Q.2 Attempt any four

a) What is service factor? Give its significance. (01 mark for definition & 01 mark significance)

Service factor: Machine tools working at different parameters like speeds, feeds than theoretical which were used while designing so it is necessary to consider actual working conditions to determine the forces, vibration frequencies etc. for smooth working of machine tool.

Service factor takes care of all such variations.

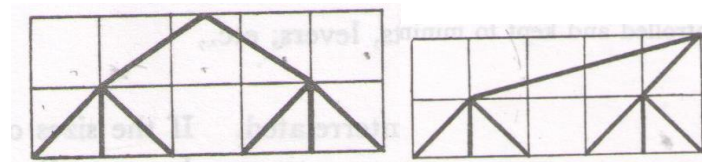
It is difficult of any machine tool to determine the parameters exactly like magnitude and direction of forces, vibrations etc., therefore we cannot predict the failure of any component of the machine tool exactly or we can't determine the exact failure stress values. Also the working environment in which machine tool works is also dynamic (continuous changing) therefore we can't predict the performance of machine tool. For all such problems it is must to consider the service factor.

b) List down the different properties of materials used for machine tool spindles. (4 points marks)

Properties of materials used for machine tool spindles. :

- a) Good Machinability.
- b) High stiffness.
- c) High damping.
- d) High wear resistance.

c) Draw open type & cross type structural diagram for structural formula 2X3X1.



02 marks for each diagram

d) What is Ray diagram? Describe significance of ray diagram with sketch. (01 definition & 03 Marks for significance)

Ans: Ray diagram: Structure diagrams are converted, for quantitative assessments of speed layouts, into a diagram called as ray diagram.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Ray diagram displays exact location of speed and then a **ray diagram** helps in calculating gear ratios. Various **ray diagrams** can result from a single structure diagram and these **diagrams** can be classified as unilateral, bilateral and skewed.

Structure diagram displays the pattern of connection of speeds at the input, output and intermediate stages without indicating the actual speeds of intermediate points and gear-ratios. Structure **diagrams** can be 'opened' or 'crossed' type. It is important that while drawing such diagram arrows must be drawn parallel when repeated for another set in the same stage to maintain same gear ratio.

e) Define aesthetics of a machine tool. State its importance for a machine tool.

Aesthetic considerations are nothing but the overall appearance look of the machine from outside.

Good appearance of the machine tool influences the mood of the worker favourably and thus facilitates better operation. It is generally conceded that a machine tool that is simple in design and safe in operation is also good in appearance, although factors, such as external finish, colour, etc. do substantially contribute to the overall aesthetic quality of the machine tool. For instance, painting of machine tools in grey-green or green-blue colours imparts a bright and pleasing appearance to the shop. Nowadays, painting of machines in different colours according to the production purpose is becoming popular, e.g., transportation facilities within the shop are painted yellow with black stripes, etc.

Meaning 01 Mark and Explanation 03 Marks

Q.3 Attempt any two

a) State the different profiles used for machine tool structure. Which profile is more preferred for use? Why? State any two applications of profile.

ii) Different profiles used in machine tool structure:-

Rectangular

Box type

Cylindrical

I-section



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

(02 marks)

Applications- Bench and radial drilling machines, planning machines, vertical Lathe, Boring Machine, Grinding machine etc

(02 marks)

Box type structures are mostly used as a machine tool structure (02 marks)

Reason:-

1. Box type section has the highest torsional stiffness.
2. The strength is high as compared to other structures.
3. Proper mating with the other surfaces.

(02 marks for any 02 reasons)

b) Draw the block diagram of design process of machine tool and describe it in detail.

1. Requirement-The customer outlines the requirements by furnishing information about the parts for machining of which he wants the machine tool to be designed.
2. Technical specification- the technical specification is the listing of parameters that are essential for the design.
3. Selection of proper kinematic solution and layout- after technical specification has been laid down the designer explores the combination of relative motions that can ensure machining of surfaces of required shapes and dimensions.
4. Design calculations- the design calculations cover the design of the major units of the machine tools such as speed box, feed box, belt. Spindle etc.
5. Drawings of components and assemblies- These drawings are made for the version that is finally selected . the drawings must be complete with dimensions, tolerances and manufacturing specifications.(Including the manufacturing method to be employed.)



Subject Code:17532

[illegible]

c) How vibrations in machine tools can be eliminated or reduced? Explain the method in brief.

1. **Change of cutting parameters:** Decrease the feed rate, depth of cut and cutting speed.
2. **Change of tool geometry:** Increase of rake angle and method of clamping of workpiece
3. **Change of characteristics of vibratory system:** The following methods can be employed:
 - (i) Use tuned undamped vibration absorbers to counteract forced vibration with constant frequency.

Example: Electromagnetic imbalance of motion.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

- (ii) Use of stiffener between table and over-arm of a horizontal milling machine, reduction of overhang of the tool in lathe, use of tighter clamping of workpiece, use of steady for long slender workpieces, etc.
- (iii) Introduction of vibration absorbers in the vibratory system especially in boring, milling and turning operations.

1. Modification of regenerative effect

- (i) The regenerative instability can be destroyed by the use of milling cutters of irregular tooth pitch for slab milling or different helix angles on successive teeth.
- (ii) The regenerative instability can be destroyed by the use of continuously variable spindle speed under programme control.

Change of cutting parameters –

For any machining operation on any machine tool, machining parameters like cutting speed feed and depth of cut are common. These parameters can be controlled very easily without any special arrangement. Vibrations induced in the components of machine tools are much dependent on one or all of these parameters. For example if an operator keeps high depth of cut or low cutting speeds for brittle materials then it will lead to uneven cutting operation which leads to chatter marks and vibrations. So by monitoring such parameters manually we can reduce vibrations to a greater extent.

Methods 04 marks & explanation 04marks

Q.4 A) Attempt any three

a) Define :

i) Common ratio

Common ratio is nothing but a geometric progression ratio which can be used to determine the speed steps.

$$\phi = \sqrt[n-1]{\frac{N_n}{N_1}}$$

Standard values for common ratio are 1.06,1.12,1.26,1.41,1.58,1.78 & 2.

ii) Range ratio



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

The range ratio is the product of velocity range (R_v) and diameter range (R_D) used to determine maximum and minimum speeds.

Standard values lie between 40-60 for lathe & for milling it is 30-40.

02 marks for each definition & standard values

b) Why feasibility of ray diagram is required? How it is analyzed?

An optimum ray diagram is one which will result in a compact gear box with less number of gears, shafts, bearings and shifting levers with a consequent minimisation of manufacturing cost. Size is minimised by minimising the shaft sizes subject to the constraints of ray and stage restriction. For minimising shaft sizes, summation of diameters of different gear box shafts have to be calculated from torque for alternative ray diagrams and the best layout is chosen. For a quick evaluation, node method is used.

02 Marks for Explanation of necessity

To check feasibility of Ray diagram:-



SUMMER – 16 EXAMINATION

Subject Code:17532

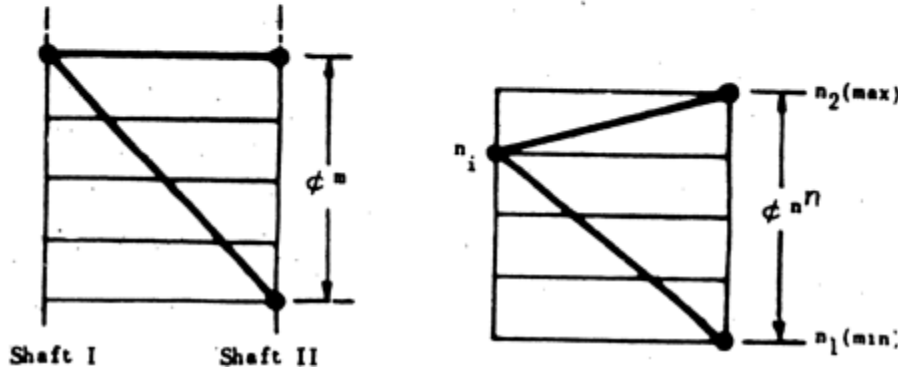
Model Answer

(i) *Ray restriction.* We know that in order to avoid interference, the minimum number of teeth in a set of gears should be greater than if (conveniently chosen as 20) and to avoid very large size gears, it should not be more than 120.

Therefore $|\phi^m|_{\max} = \frac{120}{20} = 6$ where $m =$ no. of intervening spaces.

(ii) *Stage restriction.* We further know that due to limitations of space and pitch line velocity, the transformation ratio in a gear box is constrained in the limits

$$\frac{1}{4} \leq \text{transformation ratio} \leq \frac{2}{1}$$



Looking into the following ray diagram.

$$\therefore \frac{n_2}{n_1} \leq 2; \text{ and } \frac{n_1}{n_2} \leq 4 \quad \frac{n_2}{n_1} \leq 2 \times 4 \leq 8$$

In a stage $\phi^n \leq 8$ where n is the number of intervening spaces between n_1 and n_2 .

Node Method of Optimisation

Node is a point from which a ray initiates or at which a ray terminates. Nodes are numbered from maximum speed and (corresponding to minimum torque) at each shaft and comparison is carried out with nodal sum (which, in fact, represents the sum of shaft diameters) as the criterion.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

02 Marks for Explanation of analysis

c) State and explain in brief factors affecting stiffness of machine tool structure. State in brief remedies thereof.

Factors affecting stiffness of machine tool structure:

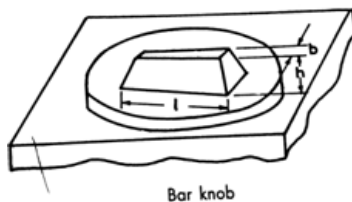
1. Bending stiffness is affected most by apertures in walls, perpendicular to the plane of bending.
2. Apertures of equal dimensions have less effect on the torsional stiffness of a structure with wider walls.
3. From among the aperture dimensions, its width has maximum effect on stiffness.
4. If there are a number of apertures in a structure the effect of those apertures that are considerably smaller than the dominant one can be neglected.
5. If there are two apertures of more or less the same size in opposite walls of a structure, the reduction coefficient k is multiplied by another coefficient $k' = 0.7 - 0.95$; the larger value of $k' = 0.95$ being used for apertures in wide walls when $b_0 = 0.5B$ and $t_0 = (0.3 - 0.5)L$.

The stiffness of the structures can be improved by using ribs and stiffeners. However it should be noted that the effect of ribs & stiffeners depends to a large extent upon how they are arranged.

Any four factors 02 marks and remedies 02 marks

d) State functions of any two knob with sketch.

- 1) for making fine adjustments
- 2) as a selector (switching knobs)



Manipulated by two
or three fingers



Manipulated by
whole hand



Continuous function
knobs

(02 marks for functions, 02 marks for sketch (any two types))



SUMMER – 16 EXAMINATION

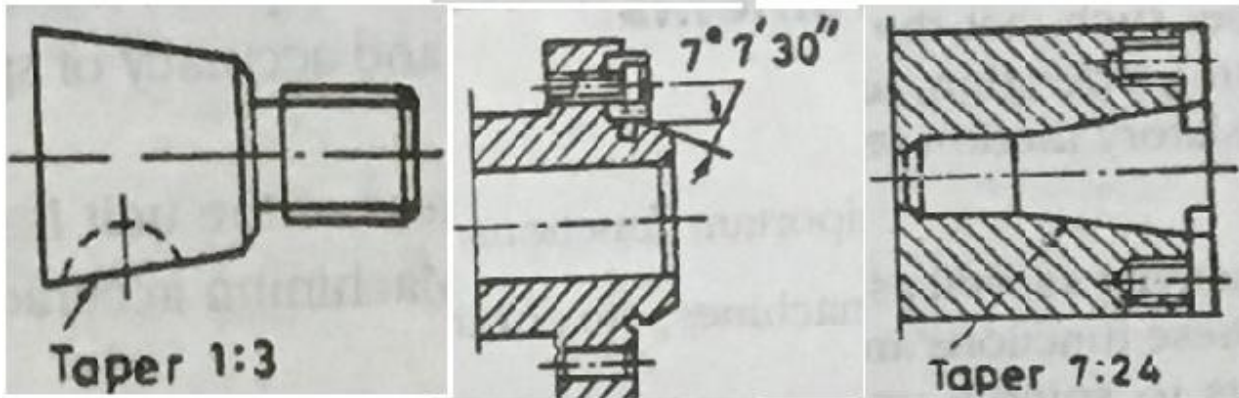
Subject Code:17532

Model Answer

B) Attempt any one

a) Draw neat sketch of any spindle unit. State its functions and also write any two requirements of it.

i)



Any one sketch 02 Marks

ii) Spindle unit of a machine tool performs the following important functions:-

- 1 Centering the workpiece e.g. In lathe, Turret, Boring etc.
- 2 Clamping the workpiece or tool during the machining operation
- 3 Imparting rotary motion (in Lathe) or rotary cum translator motion (In drilling).

Any Two points 02 Mark

iii) Two requirements of spindle unit:-

- 1 The spindle should rotate with high degree of accuracy. Accuracy of rotation must not exceed the permissible limits which are specified depending upon the required machine accuracy.
- 2 The spindle unit must have the high static stiffness. The stiffness of the unit is made up of the unit proper and the bearings. Machine accuracy is influenced by bending, axial as well as torsional stiffness.
- 3 The spindle unit must have high dynamic stiffness and damping.
- 4 The deformation of the spindle due to heat transmission should not be large.

Any Two points 02 Mark

b) Describe stepped regulation used in machine tools. State its basic types.

In stepped regulation only certain discrete values of the spindle rpm are available on the machine tool. Two extreme values (i.e. minimum and maximum) of spindle rpm are taken and intermediate steps are



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

placed in a number of ways. The various series of rpm values will have different operational characteristics.

Following are a few laws of speed range distribution

a) The rpm values constitute an arithmetic progression b) The rpm values constitute a geometric progression c) The rpm values constitute a harmonic progression d) The rpm values constitute a logarithmic progression

From the point of view of the operational efficiency of the machine tool, logarithmic progression is most suitable. The efficiency of geometrical progression is poorer in the low rpm range, whereas that of the harmonic progression is poorer in the high rpm range. Geometric progression is commonly used in machine tool drives.

Types of stepped speed regulation-

1. Belting
2. Pick off gears
3. Gear boxes

Description 04 marks & any two types 02 marks.

Q.5 Attempt any four

a) Describe the importance of location of displays by giving suitable example.

The role of displays in the man-machine system has considerably increased and certain aspects of display design and location should be treated as an integral part of design of machine. Displays are of two types- qualitative & quantitative. Qualitative display serves mostly for distinguishing between two or more operational states. The simplest example of such a display is the on/off switch or a buzzer. Quantitative displays provide quantitative information about a process.

The optimum location of displays is governed by the requirement of comfortable head position of the operator. The optimum angles of the display location, which cause least fatigue on the neck and other relevant muscles for a standing and sitting operator are approximately 30 degree above or below eye level. In view of binocular nature of human sight, the scales and indicators of displays should be positioned such that parallax is minimum. The optimum distance of the display scale from the operator's eye under different lighting conditions should be determined from the nomogram provided.

Complete description 04 marks

b) List the effects of vibration on work piece.

Effects of vibration on workpiece

1. Poor surface finish obtained at the end of machining.
2. Poor dimensional accuracy due to uneven removal of material.
3. Damage of cutting tool edge leads to chatter marks on workpiece.
4. Loss of required geometrical properties like circularity.
5. Unnecessary rise of temperature due to friction may change mechanical properties like hardness.



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Any 04 points 04 marks

c) What is speed chart? Why it is necessary? Describe with suitable example.

Speed chart can be defined as an improved structural diagram which shows no speed stage, increase in speed and reduction in speed.

Necessity:

A structural diagram only depicts the range ratio of transmission groups but gives no information about transmission ratios, in order to determine the transmission ratios of all transmissions and the r.p.m values of speed box shafts, it is necessary to plot the speed chart.

(02 for definition and 02 for explanation)

d) What are the factors on which selection of common ratio depends?

Factors on which selection of common ratio depends:-

Depending on the **common ratio**, basic series are formed; these are R_5 , R_{10} , R_{20} , R_{40} , and R_{80} . These are named as Renard series. Many other derived series are formed by multiplying or dividing the basic series by 10, 100 etc.

Typical values **of the common ratio** for four basic G.P. series are given below.

R5:	$\sqrt[5]{10}$	1.58 : 1.0, 1.6, 2.5, 4.0,...
R10:	$\sqrt[10]{10}$	1.26 : 1.0, 1.25, 1.6, 2.0,...
R20:	$\sqrt[20]{10}$	1.12 : 1.0, 1.12, 1.25, 1.4,...
R40:	$\sqrt[40]{10}$	1.06 : 1.0, 1.06, 1.12, 1.18,...

e) What are antifriction guideways? Draw sketch of any one type and describe in brief.

In anti-friction ways intermediate rolling members (balls & rollers) are inserted between the sliding surfaces, thus changing the nature of friction from sliding to rolling. The contact of rolling members with guideway surfaces occurs over a point or a line. The line or point contact follows the profile of the guideway surface and reproduce it on the machined surface.

SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

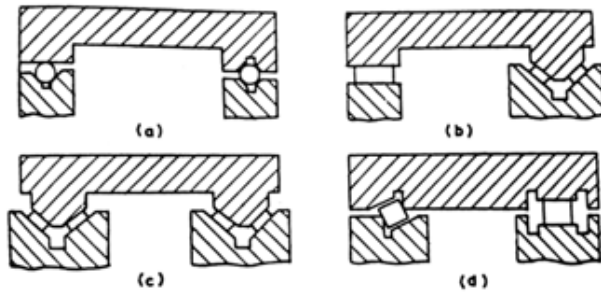


Fig. Open-type anti-friction ways

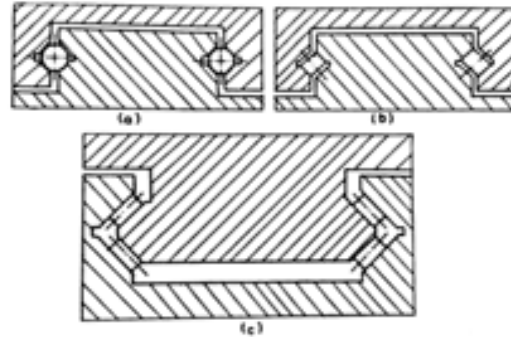


Fig. Closed-type anti-friction ways

Meaning 02 marks & sketch (any one) 02 marks

f) Define stress concentration. State causes of stress concentration.

When there are any irregularities may be due to the presence of holes, keyways, slots, shoulder, or even any inclusions or impurities in the material. If there is any change in the cross section, the distribution of stress does not remain uniform throughout and the basic relations unable to describe the state of stress at those points. The actual state of stress at a point in a mechanical part is obtained from the product of the nominal stress and the stress concentration factor at that point. Hence, stress concentration factor can be defined as the ratio of the maximum stress to the nominal stress. The stress concentration factor k_t is given by

$$k_t = \frac{\text{Actual stress at a point P}}{\text{Nominal stress at a point P}}$$

Stress concentration is highly localized effect. The variation in the stress distribution exists only in a very small region in the vicinity of the discontinuity. This region is known as zone or area of stress concentration.

Causes :

1. Surface irregularities
2. Discontinuity present in the material due to holes, keyways, slots etc.
3. Abrupt change in the cross section dimensions like shoulder
4. Non homogeneity of material

02 Marks for definition 02 for causes



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

Q.6 Attempt any four

a) Given $N_1 = 56$ rpm $N_6 = 860$ rpm. Calculate the common ratio ϕ and remaining speeds for six speed gear box.

Solution: Given data $N_1 = 56$ rpm = N_{\min} , $N_6 = 860$ rpm = N_{\max}

$\phi = ?$, $N_2 = ?$, $N_3 = ?$, $N_4 = ?$, $N_5 = ?$, $Z = ?$

$$\phi = \sqrt[6]{N_6/N_1}$$

$$\phi = \sqrt[6]{860/56}$$

$$\phi = 1.7267 \dots\dots\dots 2\text{Marks}$$

$$\text{Now, } N_2 = N_1 \times \phi = 96.67 \text{ rpm}$$

$$N_3 = N_2 \times \phi = 166.9 \text{ rpm}$$

$$N_4 = N_3 \times \phi = 288.2 \text{ rpm}$$

$$N_5 = N_4 \times \phi = 497 \text{ rpm} \dots\dots\dots 2 \text{ Marks}$$

b) What are different types of bearings used as spindle support? Describe in brief.

Bearings used as spindle support are as below-

- 1) Antifriction bearings
- 2) Sliding bearings

a) Sleeve bearings b) Hydrodynamic journal bearings c) Hydrostatic journal bearings d) Anti-lubricated bearings

The deflection of spindle nose depends, besides other factors, upon the compliance of the front and rear spindle supports. The rotational accuracy, which is one of the basic functional requirements of spindles is also greatly influenced by the choice of bearing. A machine tool spindle experiences both axial and radial loads. These loads can be either balanced by bearings that take up load radial and axial load separately or by bearings that take up both. The common requirements of spindle supports can be specified as guiding accuracy, high stiffness, minimum heating, as it can lead to additional spindle deformation, vibration stability and ability to perform satisfactorily under varying conditions of spindle rotation.

Types 02 marks & Description 02 marks



SUMMER – 16 EXAMINATION

Subject Code:17532

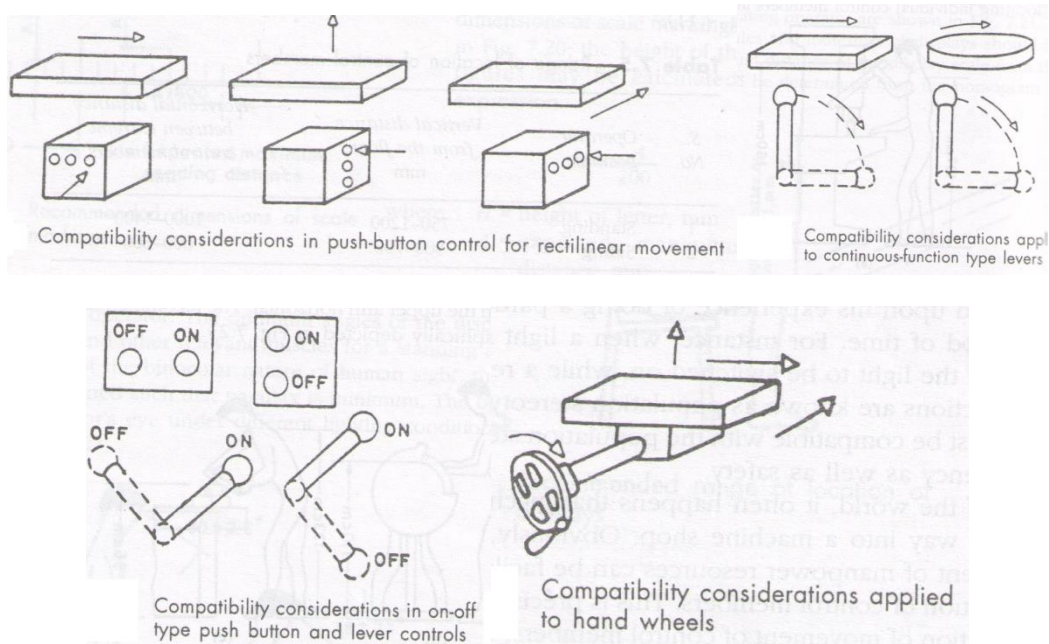
Model Answer

c) Explain the term compatibility in design of control members.

Man acquires certain reactions which are based upon his experience of doing a particular job in a particular manner over a prolonged period of time. For instance when a light switch is pushed downwards, we in India would expect just the reverse. Such reactions are known as population stereo type. The movement of control member of machine must be compatible with the population stereo type of the intended users in the interest of efficiency as well as safety.

The guiding principle of compatibility in push button control is that pressing of the right, top or farthest button should produce a movement respectively to the right, upwards or away from the operator. The application of this guiding principle is shown in figure.

In on-off type push button, toggle switches and levers, the right hand and top position indicates the on state. Continuous function type levers for translatory and circular movements are designed on the principle that the operative member should move in the same direction as the lever as shown in figure . Compatibility considerations applied to the design of rotary levers are valid for star wheels also. The compatibility considerations underlined the design of hand wheels is that when an operator facing the wheels turns it in the clockwise direction, the resulting movement of the operative member should be towards the right , upwards or away from the operator .



Brief description 02 marks & sketch 02 marks

d) State types of guideways used in following :

i) Milling machine table – Flat slideways



SUMMER – 16 EXAMINATION

Subject Code:17532

Model Answer

- ii) Carriage of lathe – Symmetrical V type slideways
- iii) Arm of radial drilling machine – Cylindrical type slideways
- iv) Compound rest of lathe – Dovetail type slideways

01 mark for each type

- e) **State four advantages of plastics as a material for slideways used in machine tools. Also write two limitations of plastic as material used in machine tool or slideways.**

Advantages of plastic as a material for slideways:

1. Uniform pressure
2. Less friction
3. Less wear
4. Easy fabrication
5. Less stiction

Disadvantages :

- a) Low speed range, $v < 40$ m/min for satisfactory working
- b) Bad thermal conductivity, hence more thermal distortion
- c) Less strength and hardness

(02 marks for advantages, any 04 and 02 for disadvantages any 02)

Moderator's remarks:

- 1) **Text Editing is required in most of the answers**
- 2) **Text Formatting is uneven between answers; try to reduce line spacing and no. of pages**
- 3) **Check the marking scheme for all the questions.**
- 4) **Check the proper allocation of all questions. (Check as per question paper)**