

VSB ENGINEERING COLLEGE
DEPARTMENT OF MECHANICAL ENGINEERING
ME6501 COMPUTER AIDED DESIGN
TWO MARKS WITH ANSWER

UNIT – 1
FUNDAMENTALS OF COMPUTER GRAPHICS

1. Define CAD.

Computer Aided Design involves any type of design activity which makes use of computer to develop, analyze or modify an engineering design. Modern CAD systems are based on interactive computer graphics.

2. Define Automated drafting.

Automated drafting involves the creation of hard copy engineering drawings directly from the CAD data base. Graphic features of computer aided design can increase productivity in drafting function.

3. Define model coordinate system.

It is defined as the reference space of the model with respect to which all the model geometric data is stored. Three types of coordinate systems are needed in order to input, store and display model geometry and graphics.

4. What is a geometric model? Mention its types.

A geometric model is a graphical representation of an object, using the mathematical database in the computer. Solid model, surface model and wireframe model are the types of geometric model.

5. Write the various design tasks performed by CAD system.

The design tasks performed by CAD system are geometric modeling, engineering analysis, design review and evaluation and automated drafting.

6. What is the graphic configuration of a graphic system?

The graphic configuration of a graphic system is,

- i) It interacts with the graphics terminal to create and alter images on the screen.
- ii) Construct a model of something physical out of the images on the screen. The models are sometimes called application models.
- iii) Enter the model into computer memory and or secondary storage.

7. What are functions of a graphic package?

The functions of a graphic package are generation of graphic elements, transformations, display control and windowing functions, segmenting functions and user input functions.

8. List the types of output devices used in conjunction with computer Aided design system.

Pen plotters, hard copy units, Electrostatic plotters, Computer-output-to-microfilm (COM) units are the output devices used in conjunction with computer aided design system.

9. What are the modules of ICG?

The interactive computer graphics software is divided into three modules as the graphics package, application software and application database.

10. Write the display devices used in computer graphics application.

Raster scan monitor, LCD monitors and plasma panel display are the display devices.

11. Define Recognition of need.

Recognition of need involves the realization by someone that a problem exists for which some corrective action should be taken. This might be identification of some defect in current machine design by an engineer or the perception of a new product marketing opportunity by salesperson. Definition of the problem involves a thorough specification of the item to be designed. The specification includes physical and functional characteristics, cost, quality and operating performance.

12. Write the analysis step of design process

Synthesis and analysis are closely related and highly iterative in the design process. A certain component or subsystem of the overall system is conceptualized by the designer, subjected to analysis, improved through this analysis procedure and redesigned. The process is repeated until the design has been optimized within the constraints imposed on the designer. The components and subsystems are synthesized into the final overall system in a similar iterative manner.

13. Define CAD. Mention areas of application of CAD.

The computers help in design and draft is commonly expressed by the term “Computer Aided Design” (CAD). A CAD system helps designer in various ways

1. Invites and promotes interaction through various input/output devices.
2. Allows manipulation of image (such as scalling, translation, rotation) in the computer screen.
3. Enable the designer to carry out the engineering analyses for stress, vibration, noise thermal distortions and more using FEA.
4. Design optimization through simulation and animation.
5. Automated drafting.

14. What is meant by concurrent engineering?

The concept and practice of various functions or departments working together, from the beginning, to engineer a product.

15. What are the advantages of Concurrent engineering?

The design decisions are taken by a team of multi disciplinary experts. Changes and modification on the product design will be faster. Higher quality.

16. What are the benefits of CAD?

New products are designed faster. CAD can drastically reduce the number of steps involved in the design process for a particular product and can also make each design step much easier and less tedious for designer to perform.

Hard copies of the drawings are of better quality. hence there will be less ambiguity and better quality.

Errors during change of design will be less.

17. What are the characteristics of concurrent engineering?

A product responsibility lies on team of multi disciplinary group. Integration of design, process planning and production will be achieved. Frequent review of design and development process.

18. Name any 3 reasons for implementing CAD in design?

1. CAD can make each design step much easier and less tedious for designer to perform.

2. Errors during change of design will be less.

3. Models generated can be easily manipulated and modification in the model can be done very easily carried out in the system itself.

19. Define computer graphics.

Computer graphics may be defined as the process of creation, storage and manipulation of drawings and pictures with the aid of a number.

20. What are the functions of IGC?

- a. Solid modeling
- b. Storage
- c. Manipulation
- d. Viewing

21. What are the various display control facilities in graphics?

Vector Generation

Windowing and viewing transformation.

Clipping transformation

Zooming

Panning

Transmitting information on a network and Graphics libraries.

22. What is the need of homogeneous coordinates?

To perform more than one transformation at a time, use homogeneous coordinates or matrixes. They reduce unwanted calculations intermediate steps saves time and memory and produce a sequence of transformations.

23. What is viewing transformation and windowing transformation?

The process of mapping from the model co-ordinate system to the screen co-ordinate system is known as viewing transformation.

The viewing transformation in which no rotation is applied is called the windowing transformation.

24. What is meant by Clipping?

Clipping is the process of determining the visible portion of a drawing lying within a window and discarding the rest.

25. State the use of reflection transformation.

It allows a copy of the object to be displayed while the object is reflected about a line or a plane.

26. What are the main types of 2D transformations?

- i. Translation
- ii. Scaling
- iii. Reflection
- iv. Rotation
- v. Shearing

27. Write a note on engineering design?

Engineering design has traditionally been accomplished on drawing boards, with design being documented in the form of a detailed engineering drawing. Mechanical design includes the drawing of the complete product as well as its components and subassemblies.

28. Define wireframe model.

A wireframe model is the simplest geometric modeling type, where an object is described by points, lines, circles, and curves in 3D representation.

29. Define Rotation

The transformation is used to rotate objects or images about any point in the world space either clockwise or anticlockwise direction. The point about which the image is rotated is called pivot point. These steps are required to perform this operation. They are

- Translate the pivot point x_p, y_p to the origin
- Rotate the translated points by θ about the origin
- Translate the centre of rotation back to the pivot point

In the first step the points (x, y) get transformed to (x', y') , and in the 2nd step (x'', y'') . In the third step to (x''', y''') . All the line segments on the objects have to be transformed to get the complete image rotated about the pivot point x_p, y_p

UNIT – 2

GEOMETRIC MODELING

1. Define geometric modeling?

The geometric modeling concerned with computer compatible mathematical description of geometry of an object. The mathematical description should be such that the image of the object can be displayed and manipulated in computer terminal, modification on the geometry can be done easily and the image can be stored in computer memory retrieve back to display in computer screen for review, analysis or alternation

2. Classify geometric modeling.

- 1.wire frame modeling.
2. Surface modeling.
- 3.solid modeling.

3. Define sculptured surface.

Sculpture surface means the surface produced by combining two families of curves that intersect one another in crisscross manner. Creating network of inter connected patches.

4. What is meant by lofted surface?

This is linear surface. It interpolates linearly between two-boundary curves.

5. List the common entities of a typical surface modeler?

1. Plane surface.
2. Ruled (lofted) surface.
3. Surface of revolution.
4. Tabulated surface.
5. Bezier surface.
6. B- spline surface.
7. Cones patch.
8. Fillet surface.
9. Offset surface.

6. Name the two basic approaches followed in solid modeling.

- a. Constructive solid geometry (CSG) or (C-rep).
- b. Boundary representation (B - rep).

7. Give any two characteristics of Bezier curves.

- a. The curve is tangent to the first and last segments of the characteristics polygon.

- b. The curve is symmetric with respect to u and $(1-u)$. Therefore, the sequence of control points defining the curve can be reversed without change of curve shape.

8. Distinguish between Bezier curves and Cubic Spline curve.

Sl.No.	Bezier curves	Cubic Spline curve
1.	The shape of Bezier curve is controlled by its defining points only	First order derivatives are used in the curve development.
2.	The curve does not pass through the given data points. Instead, these points are used to control the shape of the resulting curves.	These curves pass through the given data points only.

9. Define B-Spline curve?

A B-Spline curve is a set of piecewise(usually cubic) polynomial segments that pass close to a set of control points. However the curve does not pass through these control points, it only passes close to them.

10. What is a spline?

To produce a smooth curve through a designed set of points, a flexible strip called spline is used. Such a spline curve can be mathematically described with a piecewise cubic polynomial function whose first and second derivatives are continuous across various curve section.

11. What are the different ways of specifying spline curve?

- Using a set of boundary conditions that are imposed on the spline.
- Using the state matrix that characteristics the spline
- Using a set of blending functions that calculate the positions along the curve path by specifying combination of geometric constraints on the curve

12. Define surface model.

Surface model is similar to wireframe model where an object is described by surface entities such as B- spline, Bezier patches, coons patches, ferguson, surfaces,etc.

13. Define solid model.

Solid model is a complete representation of a surface model where the object is described by solid entities such as blocks, cylinder, cone, sphere, wedge etc. It can also be compared with an actual or existing model.

14. Define rational curve.

Rational curve is defined by the algebraic ratio of two polynomials while a non-rational curve is defined by one polynomial.

15. What are the various representation schemes used in three dimensional objects?

Boundary representation (B-res) – describe the 3 dimensional object as a set of surfaces that separate the object interior from the environment. Space- portioning representation – describe interior properties, by partitioning the spatial region containing an object into a set of small, no overlapping, contiguous solids.

16. What is surface patch?

A single surface element can be defined as the surface traced out as two parameters (u, v) take all possible values between 0 and 1 in a two-parameter representation. Such a single surface element is known as a surface patch.

17. Write short notes on rendering bi-cubic surface patches of constant u and v method?

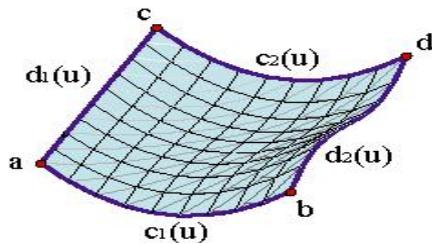
The simple way is to draw the iso-parametric lines of the surface. Discrete approximations to curves on the surface are produced by holding one parameter constant and allowing the other to vary at discrete intervals over its whole range. This produce curves of constant u and constant v.

18. What are the important properties of Bezier Curve?

- It needs only four control points
- It always passes through the first and last control points
- The curve lies entirely within the convex half formed by four control points.

19. Describe the 'Surface patch'.

Surface patch, which is used to create a surface using curves that form closed boundaries.



20. List out properties of B-Spline.

- i. The maximum order in every parametric direction is limited to the number of describing polygon vertices in that path.
- ii. The surface is changeable to an affine transformation.
- iii. The deviation diminishing property of B-spline surface is not well recognized.
- iv. The control of any polygon net vertex is limited to $\pm p/2$, $\pm q/2$ spans in the particular parametric direction.
- v. If the number of polygon net vertices is equal to the order of basis in that direction and if there are no interior knot values, then the B-spline surface decreases to a Bezier surface.

21. Write down two important solid modeling techniques.

The solid modeling techniques permit for the automation of some complicated engineering calculations that are approved as a part of the design progression. Simulation, planning, and confirmation of processes such as machining and assembly were one of the initiations for the development of solid modeling technique.

UNIT-3 VISUAL REALISM

1. Define computer graphics animation?

Computer graphics animation is the use of computer graphics equipment where the graphics output presentation dynamically changes in real time. This is often also called real time animation.

2. What is Shading?

Shading refers to depicting depth perception in 3D models or illustrations by varying levels of darkness. Shading is used in drawing for depicting levels of darkness on paper by applying media more densely or with a darker shade for darker areas, and less densely or with a lighter shade for lighter areas. There are various techniques of shading including cross hatching where perpendicular lines of varying closeness are drawn in a grid pattern to shade an area. The closer the lines are together, the darker the area appears. Likewise, the farther apart the lines are, the lighter the area appears.

Light patterns, such as objects having light and shaded areas, help when creating the illusion of depth on paper.

3. What is an algorithm?

An algorithm is a finite set of instructions that, if followed, accomplishes a particular task. In addition, all algorithms must satisfy the following criteria: 1) input 2) Output 3) Definiteness 4) Finiteness 5) Effectiveness.

4. What is scan line algorithm?

One way to fill the polygon is to apply the inside test. i.e to check whether the pixel is inside the polygon or outside the polygon and then highlight the pixel which lie inside the polygon. This approach is known as scan-line algorithm

5. What is the use shading Technique?

This technique is used to display the images in natural way. It is based on the recognition of distance and shape as a function of illumination.

6. State the hidden line elimination.

The hidden line elimination can be stated as, "For a given three dimensional scene, a given viewing point and a given direction, eliminate from an appropriate two dimensional projection of the edges and faces which the observer cannot see".

7. Classify the Visualization.

- Visualization in geometric modeling
- Visualization in scientific computing.

8. What is the need of visualization?

Visualization in geometric modeling is helpful in finding connection in the design applications. By shading the parts with various shadows, colors and transparency, the designer can recognize undesired unknown interferences. In the design of complex surfaces shading with different texture characteristics can use to find any undesired quick modifications in surface changes.

9. List out the various visualization approaches.

- Parallel projections
- Perspective projection.
- Hidden line removal
- Hidden surface removal
- Hidden solid removal
- Shaded models

10. What is hidden line removal?

Hidden line removal (HLR) is the method of computing which edges are not hidden by the faces of parts for a specified view and the display of parts in the projection of a model into a 2D plane.

11. Mention any two surface removal algorithm.

1. Z - buffer algorithm
2. Painters algorithm

12. What are the advantages and limitations of Painter's algorithm?

Advantage of painter's algorithm is the inner loops are quite easy and limitation is sorting operation.

13. What is hidden solid removal?

The hidden solid removal problem involves the view of solid models with hidden line or surface eliminated. Available hidden line algorithm and hidden surface algorithms are useable to hidden solid elimination of B-rep models.

14. Mention the advantages and limitations of ray tracking algorithm.

Advantages of Ray tracing:

1. A realistic simulation of lighting over other rendering.
2. An effect such as reflections and shadows is easy and effective.
3. Simple to implement yet yielding impressive visual results.

Limitation of ray tracing:

Scan line algorithms use data consistency to divide computations between pixels, while ray tracing normally begins the process anew, treating every eye ray separately.

15. What is powder shading?

Powder shading is a sketching shading method. In this style, the stumping powder and paper stumps are used to draw a picture. This can be in color. The stumping powder is smooth and doesn't have any shiny particles. The poster created with powder shading looks more beautiful than the original. The paper to be used should have small grains on it so that the powder remains on the paper.

16. Mention the type of shadows.

- Self-shadows and
- projected shadows.

17. How do you define complementary colours?

When two colours sources combine to produce white light, they are referred as complementary colours.

18. How are primary colour obtained?

When two or three colours are used to produce other colours in which a colour model is referred as primary colours.

19. What are the application of animation?

1. Television
2. Cinema
3. Government
4. Education

5. Business
6. Engineering

20. What are the animation types?

1. Frame-buffer animation
2. Frame-by-frame animation
3. Real-time playback
4. Real-time animation.

21. What is meant by a key frame?

A key frame is defined by its particular moment in the animation timeline as well as by all parameters or attributes associated with it.

UNIT-4 ASSEMBLY OF PARTS

1. Define Assembly modeling?

Assembly modeling is a technology and method used by computer-aided design and product visualization computer software systems to handle multiple files that represent components within a product.

2. What is tolerance analysis?

Tolerance analysis is a way of understanding how sources of variation in part dimensions and assembly constraints propagate across parts and assemblies, and how that total variation affects the capability of a design to achieve its design requirements within the process capabilities of manufacturing

3. Explain Interference checking?

Verify that your parts and assemblies will fit, assemble, and operate correctly with **SOLIDWORKS 3D CAD** software before going into production. Fully integrated with CAD, you can use Interference Check while you design to accelerate your product development process, save time and development costs, and increase productivity.

4. What is z-buffer algorithm?

In **computer graphics**, z-buffering, also known as depth buffering, is the management of image depth coordinates in **3D graphics**, usually done in hardware, sometimes in **software**. It is one solution to the **visibility problem**, which is the problem of deciding which elements of a rendered scene are visible, and which are hidden. The **painter's algorithm** is another common solution which, though less efficient, can also handle non-opaque scene elements.

When an object is rendered, the depth of a generated **pixel** (z coordinate) is stored in a **buffer** (the z-buffer or depth buffer). This buffer is usually arranged as a two-dimensional array (x-y) with one element for each screen pixel. If another object of the scene must be rendered in the same pixel, the method compares the two depths and overrides the current pixel if the object is closer to the observer. The chosen depth is then saved to the z-buffer, replacing the old one. In the end, the z-buffer will allow the method to correctly reproduce the usual depth perception: a close object hides a farther one. This is called z-culling.

5. List out techniques of assembly modeling.

- Bottom-up assembly model
- Top-down assembly model

6. Define Bottom-up assembly design.

In a 'bottom up' assembly design, complex assemblies are divided into minor subassemblies and parts. Every part is considered as individual part by one or more designers. The parts can be archived in a library in one or more 3D Files. This is the high effective way to generate and manage complex assemblies.

7. Write down Top-down assembly design.

In a 'top down' assembly design all parts are classically designed by the similar person within a single part. 3D assembly handles 'top down' method by allowing to design and creation of a component while work in the active part. Hence, the active part will be an assembly part.

8. What is mating conditions?

Components can be positioned within the product assembly using absolute coordinate placement methods or by means of mating conditions. Mating conditions are definitions of the relative position of components between each other; for example alignment of axis of two holes or distance of two faces from one another.

9. Describe parent – child relationship in assembly design.

When components are additional to an assembly, parent and child relationships are created. These relationships are displayed by graphically as an assembly tree. Parts are parametrically connected by position constraints. These constraints have data about how a part should be placed within the assembly hierarchy and how it should respond if other components are edited.

10. Define Interference free matrix.

An interference-free matrix shows interference between two components, when one component is moved, in a given assembly direction, into an assembled location, with another component already in an assembled location. Assembly actions that result in interferences are denoted as '0' in the matrix, and assembly actions that do not result in interferences are denoted as '1' in the matrix.

11. List out the advantages of Tolerance Analysis

1. Accurate part assembly.
2. Elimination of assembly rework
3. Improvement in assembly quality.
4. Reduction of assembly cost.

5. High customer satisfaction.
6. Effectiveness of out-sourcing.

12. What is the necessary of locating Center of gravity?

The necessary of center of gravity to

- Described the 'center of mass' of the object.
- The location where the object would balance.
- The single point where the static balance moments are all zero about three mutually perpendicular axis.
- The centroid of object the volume when the object is homogeneous.
- The point where the total mass of the component could be measured to be concentrated while static calculations.
- the point about where the component rotates in free space
- the point via the gravity force can be considered to perform
- the point at which an exterior force must be used to create translation of an object in space.

13. Define tolerance stack-up

Tolerance stack-up computations show the collective effect of part tolerance with respect to an assembly need. The tolerances 'stacking up' would describe to adding tolerances to obtain total part tolerance, then evaluating that to the existing gap in order to see if the design will work suitably.

14. Define Tolerance Analysis.

Tolerance analysis is a title to a different approaches applied in product design to know how deficiencies in parts as they are manufactured, and in assemblies, influence the ability of a product to meet customer needs.

15. Define mass.

Mass is the amount of matter contained in an object.

16. Define interference checking.

Interference checking is the process of checking if any parts of an assembly pierce each other or not.

17. List down the methods for tolerance analysis.

1. Worst-case arithmetic method
2. Worst-case statistical method
3. Monte Carlo simulation method.

18. Write down techniques in evaluation of assembly sequence.

1. Precedence diagram
2. Liaison-Sequence analysis
3. Precedence

19. Define: Deviation and Zero line.

Deviation is the difference between actual size and the basic size.

Zero line is a line that represents basic size. Deviations are referred to this line.

20. What are the factors that influence the amount of tolerance to be given on a part?

1. Function of the product.
2. Manufacturing process available
3. Cost of production.

UNIT-5

CAD STANDARDS

1. Define Graphical Kernel System.

The Graphical Kernel System (GKS) was the first ISO standard for low-level computer graphics, introduced in 1977. GKS provides a set of drawing features for two-dimensional vector graphics suitable for charting and similar duties. The calls are designed to be portable across different programming languages, graphics devices and hardware, so that applications written to use GKS will be readily portable to many platforms and devices.

2. What is OpenGL?

OpenGL (Open Graphics Library) is a cross-language, multi-platform application programming interface (API) for rendering 2D and 3D vector graphics. The API is typically used to interact with a graphics processing unit (GPU), to achieve hardware-accelerated rendering.

3. What is IGES?

The Initial Graphics Exchange Specification (IGES) (pronounced eye-jess) is a vendor-neutral file format that allows the digital exchange of information among computer-aided design (CAD) systems.

4. Define Data Exchange Standards.

CAD data exchange involves a number of software technologies and methods to translate data from one Computer-aided design system to another CAD file format. This PLM technology is required to facilitate collaborative work (CPD) between OEMs and their suppliers.

5. What is Standards?

What are the organizations involved in standard creation committee? Standards are necessary to ensure that products from different manufacturers can work together as expected. The ISO, ITU-T, ANSI, IEEE, and EIA are some of the organizations involved in standards creation

6. Write the functions of GKS.

1. Regeneration and transformation of images
2. Image generated in user co-ordinate
3. Controlling the activities of work station
4. Structuring the cell arrays and there by generating images

7. List out the international organizations involved to develop the graphics standards:

- ACM (Association for Computer Machinery)
- ANSI (American National Standards Institute)
- ISO (International Standards Organization)

- GIN (German Standards Institute)
CALDS, GKS, PHIGS, VDI, VDM, NAPLPS

8. List out the various standards in graphics programming

- IGES (Initial Graphics Exchange Specification)
- DXF (Drawing / Data Exchange Format)
- STEP (Standard for the Exchange of Product model data)

9. Define Graphics Kernel System (GKS)

The Graphical Kernel System (GKS) was the first ISO standard for computer graphics in low-level, established in 1977. GKS offers a group of drawing aspects for 2D vector graphics appropriate for mapping and related duties.

10. Enumerate Open Graphics Library.

OpenGL draws primitives into a structured buffer focus to a various selectable modes. Every Point, line, polygon, or bitmap are called as a primitive. Each mode can be modified separately; the parameters of one do not affect the parameters of others.

11. Narrate IRIS GL.

OpenGL is supported on Silicon Graphics' Integrated Rater Imaging System Graphics Library (IRIS GL). Though it would have been potential to have designed a totally new Application Programmer's Interface (API), practice with IRIS GL offered insight into what programmers need and don't need in a Three Dimensional graphics API

12. Define NAPLPS

NAPLPS (North American Presentation- Level Protocol Syntax) describes text and graphics in the form of sequences of bytes in ASCII code.

13. Define IGES

IGES (Initial Graphics Exchange Specification) enables an exchange of model data basis among CAD system

14. Define DXF

DXF (Drawing / Data Exchange Format) file format was meant to provide an exact representation of the data in the standard CAD file format.

15. Define STEP

STEP (Standard for the Exchange of Product model data) can be used to exchange data between CAD, Computer Aided Manufacturing (CAM) , Computer Aided Engineering (CAE) , product data management/enterprise data modeling (PDES) and other CAD systems.

16. Define GKS

GKS (Graphics Kernel System) provides a set of drawing features for two-dimensional vector graphics suitable for charting and similar duties.

17. Define, PHIGS

PHIGS (Programmer's Hierarchical Interactive Graphic System) The PHIGS standard defines a set of functions and data structures to be used by a programmer to manipulate and display 3-D graphical objects.

18. List the various file sections in IGES.

- I. Flag.
- II. Start section.
- III. Global section.
- IV. Directory section.
- V. Parameter data section.
- VI. Termination section.

19. List down the requirements of data exchange.

- i. Shape data.
- ii. Non-shape data.
- iii. Design data.
- iv. Manufacturing data.

20. State the methods of data exchange.

- I. Direct CAD system export/import.
- II. Direct translation software.
- III. Neutral data exchange format.

METROLOGY

QUESTION BANK

UNIT I

CONCEPT OF MEASUREMENTS

1. What is Range of measurement? (NOV/DEC 2013)

The physical variables that are measured between two values. One is the higher calibration value H, and the other is Lower value L, The difference between H, and L, is called range.

2. What is Resolution?(NOV/DEC 2014)

The minimum value of the input signal is required to cause an appreciable change in the output known as resolution.

3. Distinguish between sensitivity and range with suitable example.

Example: An Instrument has a scale reading of 0.01mm to 100mm. Here, the sensitivity of the instrument is 0.01mm i.e. the minimum value in the scale by which the instrument can read. The range is 0.01 to 100mm i.e. the minimum to maximum value by which the instrument can read.

4. Define system error and correction.(MAY/JUNE2012)

Error: The deviation between the results of measured value to the actual value.

Correction: The numerical value which should be added to the measured value to get the correct result.

5. Define: Measurand.

Measurand is the physical quantity or property like length, diameter, and angle to be measured.

6. Define: Deterministic Metrology. (NOV/DEC 2013)

The metrology in which part measurement is replaced by process measurement. The new techniques such as 3D error compensation by CNC systems are applied.

7. Define over damped and under damped system.(NOV/DEC2011)

Over damped - The final indication of measurement is approached exponentially from one side.

Under damped - The pointer approaches the position corresponding to final reading and makes a number of oscillations around it.

8. Explain any four methods of measurement

1. Direct method.
2. Indirect method.
3. Comparison method.
4. Coincidence method.

9. classification of measuring instruments. (NOV/DEC 2013)

1. Angle measuring Instruments.
2. Length measuring Instruments.
3. Instruments for surface finish.
4. Instruments for deviations.

10. Define True size.

True size is Theoretical size of a dimension.

11. Define Actual size.

Actual size = Size obtained through measurement with permissible error.

12. What is Hysteresis?

All the energy put into the stressed component when loaded is not recovered upon unloading. So, the output of measurement partially depends on input called hysteresis.

13. Differentiate accuracy and Uncertainty with example.

Accuracy - Closeness to the true value.
Example: Measuring accuracy is $\pm 0.02\text{mm}$ for diameter 25mm.
Here the measurement true values lie between 24.98 to 25.02 mm
Uncertainty about the true value = $\pm 0.02\text{mm}$

14. Define Span. **?(NOV/DEC 2015)**

The algebraic difference between higher calibration values to lower calibration value.
Example: In a measurement of temperature higher value is 200°C and lower value is 150°C means span = $200 - 150 = 50^\circ\text{C}$.

15. Differentiate between precision and accuracy.

Accuracy - The maximum amount by which the result differ from true value.
Precision - Degree of repetitiveness. If an instrument is not precise it will give different results for the same dimension for the repeated readings.

16. What is Scale interval?

It is the difference between two successive scale marks in units.

17. What is Response Time? **?(NOV/DEC 2015)**

The time at which the instrument begins its response for a change measured quantity.

18. Define Repeatability.

The ability of the measuring instrument to repeat the same results of the actual measurements for the same quantity is known as repeatability.

19. Explain the term magnification.

It means the magnitude of output signal of measuring instrument time's increases to make it more readable.

20. Classify the Absolute error.

The absolute error is classified into

1. True absolute error.
2. Apparent absolute error.

21. What is Relative error?

Relative error is defined as the results of the absolute error and the, value of comparison used for calculation of that absolute error. The comparison may be true value or conventional true value or arithmetic mean for series of measurement.

22. Classify the errors.

The errors can be classified into

1. Static errors - Reading errors
 - Characteristic errors,
 - Environmental errors
2. Loading errors
3. Dynamic error.

23. What is the basic Principle of measurement?

It is the physical phenomenon utilized in the measurement. If energy kind of quantity measured, there must be a unit to measure it. So this will give the quantity to be measured in number of that unit.

24. What are the applications of Legal metrology?

1. Industrial Measurements.
2. Commercial transactions.
3. Public health and human safety ensuring.

<p>25. What is the need of inspection? ?(NOV/DEC 2015) To determine the fitness of new made materials, products or component part and to compare the materials, products to the established standard.</p>
<p>26. What are the important elements of measurements? The important elements of a measurement is</p> <ol style="list-style-type: none"> 1. Measurand. 2. Reference. 3. Comparator
<p>27. What is LEGAL METROLOGY? ?(NOV/DEC 2015) Legal metrology is part of Metrology and it is directed by a National Organization which is called "Notional service of Legal Metrology". The main objective is to, maintain uniformity of measurement in a particular country.</p>
<p>PART-B (16 MARKS) DESCRIPTIVE TYPE QUESTIONS</p>
<p>1. Give the Structure of Generalized Measurement system and Explain in details? (NOV/DEC 2013)</p>
<p>2. Enumerate the desirable characteristics of precision measuring instrument? (NOV/DEC 2013)</p>
<p>3. Describe the different types of error in measurement and their causes ? (NOV/DEC 2013)</p>
<p>4. Define Calibration and interchangeability? Explain the purpose of calibrating and discuss various calibrating systems(MAY/JUNE 2014)</p>
<p>5. Briefly explain the various types of input signal?(NOV/DEC 2012)</p>
<p>6. What are the various Elements of Metrology? with example ,explain how these elements influence the accuracy of measurement?(NOV/DEC 2015)</p>
<p>UNIT II LINEAR AND ANGULAR MEASUREMENTS</p>
<p>1. What are the considerations while manufacturing the slip gauges? The following additional operations are carried out to obtain the necessary qualities in slip gauges during manufacture.</p> <ol style="list-style-type: none"> 1. First the approximate size of slip gauges is done by preliminary operations. 2. The blocks are hardened and wear resistant by a special heat treatment process. 3. To stabilize the whole life of blocks, seasoning process is done. 4. The approximate required dimension is done by a final grinding process.
<p>2. How do you calibrate the slip gauges ?(NOV/DEC 2015) Comparators are used to calibrate the slip gauges.</p>
<p>3. List the various linear measurements?</p> <ol style="list-style-type: none"> (i) Length. (ii) Heights and (iii) Thickness.
<p>4. What are the various types of linear measuring instruments? The various devices used for measuring the linear measurements are</p> <ol style="list-style-type: none"> i. Vernier calipers. ii. Micrometers.

<p>iii. Slip gauge or gauge blocks. Comparator</p>
<p>5. List out any four angular measuring instrument used in metrology. ?(NOV/DEC 2015)</p> <p>(i) Angle gauges. (ii) Divided scales. (iii) Sine bar with slip gauges. (iv) Autocollimator. (v) Angle dekkor.</p>
<p>6. Classify the comparator according to the principles used for obtaining magnification. (NOV/DEC 2013)</p> <p>The common types are:</p> <p>(i) Mechanical comparators. (ii) Electrical comparators. (iii) Optical comparators. (iv) Pneumatic comparators.</p>
<p>7. What are comparators? Comparators are one form of linear measurement device which is quick and more convenient for checking large number of identical dimensions.</p>
<p>8. How the mechanical comparator works? The method of magnifying small movement of the indicator in all mechanical comparators are effected by means of levers, gear trains or a combination of these elements.</p>
<p>9. State the best example of a mechanical comparator. A dial indicator or dial gauge is used as a mechanical comparator.</p>
<p>10. Define least count and mention the least count of a mechanical comparator. Least count. - The least value that can be measured by using any measuring instrument known as least count. Least count of a mechanical comparator is 0.01 mm.</p>
<p>11. How the mechanical comparator is used? State with any one example. Let us assume that the required height of the component is 32.5mm. Initially, this height is built up with slip gauges. The slip gauge blocks are placed under the stem of the dial gauge. The pointer in the dial gauge is adjusted to zero. The slip gauges are removed- Now, the component to be checked is introduced under the stem of the dial gauge. If there is any deviation in the height of the component, it will be indicated by the pointer.</p>
<p>12. State any four advantages of reed type mechanical comparator. ?(NOV/DEC 2015)</p> <p>(i) It is usually robust, compact and easy to handle. (ii) There is no external supply such as electricity, air required. (iii) It has very simple mechanism and is cheaper when compared to other types. (iv) It is suitable for ordinary workshop and also easily portable.</p>
<p>13. Mention any two disadvantages of reed type mechanical comparator. (NOV/DEC 2013)</p> <p>(i) Accuracy of the comparator mainly depends on the accuracy of the rack and pinion arrangement. Any slackness will reduce accuracy. (ii) It has more moving parts and hence friction is more and accuracy is less.</p>
<p>14. What are the major types of an electrical comparator? An electrical comparator consists of the following three major parts such as</p>

- (i) Transducer.
- (ii) Display device as meter.
- (iii) Amplifier.

15. On what basis the transducer works? **?(NOV/DEC 2015)**

An iron armature is provided in between two coils held by a leaf spring at one end. The other end is supported against a plunger. The two coils act as two arms of an A.C. wheat stone bridge circuit.

16. How is the accuracy of an electrical comparator checked?

To check the accuracy of a given specimen or work, first a standard specimen is placed under the plunger. After this, the resistance of wheat stone bridge is adjusted that the scale reading shows zero. Then the specimen is removed. Now, the work is introduced under the plunger.

17. State the working principle of an electronic comparator.

In electronic comparator, transducer induction or the principle of application of frequency modulation or radio oscillation is followed.

18. Mention the important parts of an electronic comparator. **(NOV/DEC2012)**

- (i) Transducer.
- (ii) Oscillator.
- (iii) Amplifier.
- (iv) Demodulator.
- (v) Meter.

19. Classify pneumatic comparators.

- (i) Flow or Velocity type.
- (ii) Back pressure type.

20. What are the advantages of electrical and electronic comparator?

- (i) It has less number of moving parts.
- (ii) Magnification obtained is very high.
- (iii) Two or more magnifications are provided in the same instrument to use various ranges.
- (iv) The pointer is made very light so that it 'IS more sensitive to vibration.

21. What are the disadvantages of electrical and electronic comparator?

- (i) External agency is required to meter for actuation.
- (ii) Variation of voltage or frequency may affect the accuracy of output.
- (iv) Due to heating coils, the accuracy decreases.

It is more expensive than mechanical comparator

22. List the various parts of an optical comparator. **(NOV/DEC2012)**

The optical comparator consists of the following parts such as

- (i) Pivoted lever.
- (ii) Objective lens
- (iii) Scale.
- (iv) Plunger.
- (iv) Table

23. What are the advantages of pneumatic comparators?

- (i) The wear of measuring heads is avoided due to absence of direct contact.
- (ii) Friction is less due to less number of moving parts.
- (iii) Work piece is cleaned by supplying of all during the measurement.
- (iv) High magnification is possible.

- (v) There is no interference of measuring head and indicating device because the measuring head is kept away from the indicating device.
- (vi) It is a suitable method to check taperness of circular bore.

PART-B (16 MARKS)
DESCRIPTIVE TYPE QUESTIONS

1. With a neat diagram explain the working of SINE BAR and Angle Dekkar?(NOV/DEC2013)
2. Explain the Working Principle of AC Laser Interferometer and explain how the Straightness is measure?(NOV/DEC 2015)
3. Explain with a Schematic sketch the working Principle of solex pneumatic comparator?(MAY/JUNE2014)
4. Describe the working principle, advantages and disadvantages of optical comparator?(MAY/JUNE2014)
5. Explain the working principle of Angle Dekkar with a neat sketch .Also Write the application of angle dekkar?(NOV/DEC2015)
6. Explain the following with neat sketches:(NOV/DEC2012)
 - (i) Differential screw micrometer
 - (ii) Thread Micrometer
 - (iii) Blade Type Micrometer
 - (iv) Micrometer Thread Gauge

UNIT 3
FORM MEASUREMENT

1. Name the various types of pitch errors found in screw? (NOV/DEC2012)
 - (i) Progressive error.
 - (ii) Drunken error.
 - (iii) Periodic error.
 - (iv) Irregular errors.
2. Name the various methods of measuring the minor diameter of the thread. (NOV/DEC2012)
 - (i) Using taper parallels.
 - (ii) Using rollers and slip gauges.
3. Name the various methods used for measuring the major diameter?
 - (i) Ordinary micrometer.
 - (ii) Bench micro meter.
4. Name the various methods for measuring effective diameter.
 - (i) One wire method.
 - (ii) Two wire method.
 - (iii) Three wire method.
5. Name the various methods for measuring pitch diameter.
 - (i) Pitch measuring machine.

<ul style="list-style-type: none"> (ii) Tool maker. (iii) Screw pitch gauge.
<p>6. Name the two corrections are to be applied in the measurement of effective diameter. (NOV/DEC 2015)</p> <ul style="list-style-type: none"> (i) Rake corrections Compression correction
<p>7. What is best size of wire?</p> <p>Best size of wire is a wire of such diameter that it makes contact with the flanks of the thread on the pitch line.</p>
<p>8. Define. Drunken thread</p> <p>This is one, having erratic pitch, in which the advance Of the helix is irregular in one complete revolution of thread.</p>
<p>9. What is the effect of flank angle error? (NOV/DEC2012)</p> <p>Errors in the flank cause a virtual increase in the effective diameter of a bolt and decrease in that, of nut.</p>
<p>10. What are the applications of toolmaker's microscope?</p> <ul style="list-style-type: none"> (i) Linear measurement. (ii) Measurement of pitch of the screw. (iii) Measurement of thread angle.
<p>11. Define: Periodic error.</p> <p>The periodic error repeats itself at equal intervals along the thread.</p>
<p>12. What are the commonly used forms of gear teeth?</p> <ul style="list-style-type: none"> (1) Involutes. (2) Cycloidal.
<p>13. What are the types of gears? (NOV/DEC2012)</p> <ul style="list-style-type: none"> (i) Spur. (ii) Helical. (iii) Bevel. (iv) Worth and Worm wheel. (v) Rack and pinion.
<p>14. Define: Module.</p> <p>Module= pitch circle diameter/ number of teeth.</p>
<p>15. Define: Lead angle.</p> <p>It is the angle between the tangent to the helix and plane perpendicular to the axis of cylinder.</p>
<p>16. What are the various methods used for measuring the gear tooth thickness?</p> <ul style="list-style-type: none"> (i) Gear tooth Vernier. (ii) Constant chord method.
<ul style="list-style-type: none"> (iii) Base tangent method.

(iv) Measurement over pins.
17. Name four gear errors. (NOV/DEC 2013) (i) Pitch error. (ii) Alignment error. (iii) Composite error. (iv) Thickness error.
18. Name the method used for checking the pitch of the gear. ?(MAY/JUNE2014) (i) Step by step method. (ii) Direct angular measurement.
19. What are the direct angular measurements methods? 1. Profile checking: a) Optical projection method. b) Involute measuring method. 2. Thickness measurement: a) Chordal thickness method. b) Constant chord method.
20. Define: constant chord. Constant chord is the chord joining those points, or opposite Addendums of the tooth.
21. Give the formula for measuring radius of circle. $R = \frac{(I - d)^2}{8d}$ Where, R=Radius of the job I = Distance between the balls d = Diameter of pins.
22. What are the two methods used in measuring radius of concave surface? (NOV/DEC2012) a) Edges are well defined. b) Edges are rounded up.
23. What are the factors affecting surface roughness? a) Vibrations. b) Material of the work piece. c) Tool d) Machining type.
24. What are the methods used for evaluating the surface finish? a) Peak to valley height method. b) The average roughness method. c) Form factor method.
25. Define fullness and emptiness in form factor. ?(MAY/JUNE2014) Degree of fullness (K)= area of metal /Area of enveloping rectangle Degree of emptiness = 1 – K.
26. What are the methods used for measuring surface roughness? a) Inspection by comparison b) Direct instrument measurements.
27. What are the stylus probe instruments? a) Profilometer. b) Taylor Hobson Talysurf. c) Tomlinson surface meter.
28. Define: Straightness of a line in two planes. A line is said to be straight over a given length, if the variation of the distance of its points from two planes perpendicular to each other and parallel to the direction of a line remaining within the

specified tolerance limits
<p>29. Define: Roundness. Name the four measurement of roundness. It is a surface of revolution where all the surfaces intersected 'by any plane perpendicular to a common axis in case of, cylinder and cone.</p> <p>a. Heart square circle. b. Minimum radial separation circle. c. Maximum inscribed circle. d. Minimum circumscribed circle</p>
<p>30. Name the devices used for measurement of roundness.</p> <p>1. Diametral. 2. Circumferential confining gauge. 3. Rotating on center. 4. V-Block. 5. Three point probe. 6. Accurate spindle.</p>
<p>31. What is run out? ?(MAY/JUNE2014) Run out. -Total range of reading of a fixed indicate Or with the contact points applied to a Surface rotated, without axial movement, about 3 fixed axis</p>
<p>PART-B (16 MARKS)</p> <p>DESCRIPTIVE TYPE QUESTIONS</p>
<p>1. Explain the following Direct Instrument Measurements: (i)Stylus Probe type Instrument ii)Tomlinson Surface meter.(NOV/DEC2013)</p>
<p>2. Explain how V-Block and three point probe are used for measurement of roundness . What are the Limitation of V-Block?(NOV/DEC2013)</p>
<p>3. Explain with a neat sketch the working of Talysurf instrument for surface finish measurement?(MAY/JUNE 2014)</p>
<p>4. Describe the two wire method of finding the effective diameter of screw threads?(MAY/JUNE 2014)</p>
<p>5. Expaline the following tooth thickness measurement (i)Constant chord method(ii)Chordal thickness method? (NOV/DEC2012)</p>
<p>6. Write briefly about the Various stages involved in Machine Vision?(NOV/DEC2015)</p>
<p>UNIT 4</p> <p>LASER AND ADVANCES IN METROLOGY</p>
<p>1. Explain briefly the three important fields of machine vision system ?(NOV/DEC 2015) Inspection: it is the ability of an automated vision system to recognize well-defined pattern and if these pattern match these stored in the system makes machine vision ideal for inspection of raw materials, parts, assemblies etc. Part identification: It is the ability of part recognition provides positive identifications of an object for decision-making purposes. Guidance and Control. Machine vision systems are used to provide sensor feedback for real time guidance.</p>
<p>2 What is interferometer? Interferometer is optical instruments used for measuring flatness and determining the lengths of slip gauges by direct reference to the wavelength of light.</p>
<p>3 Name the different types of interferometer ?(NOV/DEC 2015) 1) NPL flatness interferometer.</p>

<p>2) Michelson interferometer.</p> <p>3) Laser interferometer.</p> <p>4) Zesis gauge block interferometer.</p>
<p>4 Name the common source of light used for interferometer?</p> <p>a. Mercury 198.</p> <p>b. Cad minus.</p> <p>c. Krypton 86.</p> <p>d. Helium.</p> <p>e. Hydrogen.</p>
<p>5 What is crest and trough?</p> <p>The light is a form of energy being propagated by electromagnetic waves, which is a sine curve. The high point of the wave is called crust and the low Point is called is trough.</p>
<p>6. What is meant by alignment test on machine tools?</p> <p>The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool.</p>
<p>7. List the various geometrical checks made on machine tools.</p> <p>a. Straghtness of guide ways and slide ways of machine tool.</p> <p>b. Flatness of machine tables and slide ways.</p> <p>c. Parallelism, equidistance and alignment of the slide ways.</p> <p>d. True running and alignment of shaft and spindle.</p> <p>e. The pitch error or lead of lead screw.</p> <p>f. Pitch errors of gears.</p>
<p>8. What is wavelength?</p> <p>The distance between two crusts or two rough is called the wavelength.</p>
<p>9. Distinguish between geometrical test and practical test on a machine tool.</p> <p>The alignment test is carried out to check the grade of manufacturing accuracy of the machine tool. Performance test consist of checking the accuracy of the finished component. Alignment test consist of checking the relationship between various machine elements when the machine tool is idle. Performance test consists of preparing the actual test jobs on the machine and checking the accuracy of the jobs produced.</p>
<p>10. What are the main spindle errors? (NOV/DEC 2013)</p> <p>a) Out of round.</p> <p>b) Eccentricity.</p> <p>c) Radial throws of an axis.</p> <p>d) Run out.</p> <p>e) Periodical axial slip.</p>
<p>11. Write the various tests conducted on any machine tools?(NOV/DEC 2015)</p> <p>1. Test for level of installation of machine tool in horizontal and vertical planes.</p> <p>2. Test for flatness of machine bed and for straightness and parallelism of bed ways on bearing surface.</p> <p>3. Test for perpendicularity of guide ways to other guide ways.</p> <p>4. Test for true running of the main spindle and its axial movements.</p>
<p>12. Why the laser is used in alignment testing?</p> <p>The alignment tests can be carried out over greater distances and to a greater degree of accuracy using laser equipment. Laser equipment produces real straight line, whereas an alignment telescope provides a, imaginary line that cannot be seen in space.</p>
<p>13. Classify the machine tool test.</p> <p>It can be classified into</p> <p>1. Static tests.</p> <p>2. Dynamic tests.</p>
<p>14. What are the different types of geometrical tests conducted on machine tools?</p> <p>1. Straightness.</p>

2. Flatness. 3. Parallelism, equi-distance and coincidence
15. What is CMM? ?(MAY/JUNE2014) It is a three dimensional measurements for various components. These machines have precise movement is x, y, z coordinates which can be easily controlled and measured. Each slide in three directions is equipped with a precision linear measurement transducer which gives digital display and senses positive and negative direction.
16. What is the principle of laser? The photon emitted during stimulated emission has the same energy, phase and frequency as the incident photon. This principle states that the photon comes in contact with another atom or molecule in the higher energy level E_2 then it will cause the atom to return to ground state energy level E_1 , by releasing another photon. The sequence of triggered identical photon from stimulated at E_2 is known as stimulated emission. This multiplication of photon through stimulated emission' leads to coherent, powerful, monochromatic, collimated beam of light emission. This light emission is called laser
17. Define axial length measuring accuracy. It is defined as difference between the references lengths of gauges aligned with a machine axis and the corresponding measurement results from the machine.
18. Write the types of coordinate measuring machines? 1. Bridge type. 2. Horizontal bore mill. 3. Vertical bore mill. 4. Spherical coordinate measuring machine.
19. Explain CNC, CMM briefly. A computer numerical control system can be used with CN4M to do calculations while measuring complex parts. Error can be stored in memory while doing calculations. For automatic calibration of probe, determination of co-ordinate system, calculation, evaluation and recording etc., special software's are incorporated.
20. Write some features of CMM software. Measurement of diameter, center distance can be measured as follows: 1. Measurement of plane and spatial curves. 2. Minimize CNC programme. 3. Data communications. 4. Digital input and output command 5. Interface to CAD software.
21. What are the four basic types of machine, vision system? (NOV/DEC 2013) (i) Image formation. (ii) Processing of image. (iii) Analyzing the image. (iv) Interpretation of image.
22. Write the advantages of machine vision system. (i) Reduction of tooling and fixture cash. (ii) Elimination of need for precise part location. (iii) Integrated automation of dimensional verification (iv) Defect detection.
23. Define machine vision. (NOV/DEC 2013) Machine vision can be defined as a means of simulating the image recognition and analysis capabilities of the human system with electronic and electromechanical techniques.
24. Define grayscale analysis. In these techniques, discrete areas or windows are formed around only the portions of the image to be inspected. For determining if brackets are present, high intensity lighting is positioned. This type of

discrete area analysis is a powerful tool and can be used for inspection of absence, correct part assembly, orientation, part, integrity, etc.
<p>25. Mention the advantages of CMM.</p> <ul style="list-style-type: none"> (i) The inspection rate is increased. (ii) Accuracy is reduced. (iii) Operator's error can be minimized. Skill of the operator is reduced. (iv) Reduction in calculating, recording and set up time. (v) No need of GO/NOGO gauges. <p>Reduction of scrap and good part rejection</p>
<p>26. Mention the disadvantages of CMM.</p> <ul style="list-style-type: none"> (i) The table and probe may not be in perfect alignment. (ii) The stylus may have run out. (iii) The stylus moving in z-axis may have some perpendicularity errors. (iv) Stylus while moving in x and y direction may not be square to each other. (v) There may be errors in digital system.
<p>27. Mention the application of CMM. ?(MAY/JUNE2014)</p> <ul style="list-style-type: none"> (i) CMM's to find application in automobile., machine to.,electronics, space and many other large companies. (ii) These are best suited for the test and inspection Of test equipment, gauges and tools. (iii) For aircraft and space vehicles of hundred Percent inspections is carried out by using CMM. (iv) CMM can be used for determining dimensional accuracy of the component. (v) CMM can also be used for sorting tasks to achieve optimum pacing of components within tolerance limits.
<p>28. Describe the features of a flexible inspection system. ?(MAY/JUNE2014)</p> <ul style="list-style-type: none"> (i) A powerful computer serves as a real time processor to handle part dimensional data and as a multi 'programming system to perform such tasks as manufacturing process control. (ii) The terminal provides interactive communication with personnel Computer where the programmes are stored. (iii) Input devices microprocessor based gauges and other inspection devices are used in CMM.
<p>29. Write brief note about</p> <ul style="list-style-type: none"> (i) Co-ordinate measuring machine equipped with a laser probe? (ii) Virtual measuring system
<p>PART-B (16 MARKS)</p> <p>DESCRIPTIVE TYPE QUESTIONS</p>
<p>1. Explain the construction details of column type of CMM? Mention the Advantages and Disadvantages ?(MAY/JUNE 2014)</p>
<p>2. Explain in Details the various method of testing accuracy of horizontal milling m/c and lathe using laser Interferometer?(MAY/JUNE 2014)</p>
<p>3. Explain the Various types of co-ordinate measuring machine with a neat sketch?(NOV/DEC2013)</p>
<p>4. With a neat sketch explain the dimensional measurement using scanning laser gauge?(NOV/DEC2013)</p>
<p>5. Explain the construction and working of a laser Telemetric with a neat sketch?(NOV/DEC2012)</p>
<p>6. Explain the construction and working principle of various bridge type co-ordinate measuring machine?(NOV/DEC2012)</p>

UNIT 5
MEASUREMENT OF MECHANICAL PARAMETERS

1. What are load cells?

Are devices for the measurement of force through indirect methods

2. Give the principle of hot wire anemometer.

When a fluid flows over a heated surface heat is transferred from the surface and so the temperature reduces. The rate of reduction of temperature is related to flow rate.

3. State any four inferential type of flow meters ?(NOV/DEC 2015)

- **Venturi meter.**
- **Orifice meter.**
- **Rota meter.**
- **Pitot tube.**

4 What is the principle involved in fluid expansion thermometer?

Change in pressure in the bulb is taken as an indication of the temperature.

5. Mention some instruments used to measure negative pressures.

- McLeod gauge
- Kundsens Gauge.
- Pirani Gauge.
- Ionization Type Gauge.

6. Name the two types of hot wire anemometer. ?(NOV/DEC 2015)

- Costant Current Type.
- Constant Temperature Type.

7. What is an Anemometer?

An anemometer is a device for measuring mean and fluctuating velocities in fluid flows. The reduction of temperature of a surface resulting from the heat transferred owing to the fluid flow is related to flow rate.

8 What is thermocouple?

When two metals are joined together it will create an emf and it is primarily a function of the junction temperature.

9. What is a Kentometer? ?(MAY/JUNE2014)

It is a device for measurement of absolute pressure

10. What is thermopile?

When thermocouples are connected in series it is called thermopile.

11. Write the working principles of hot wire anemometer.

When the fluid flows over heated surface heat is transferred from the surface and so, its temperature reduces. The rate of reduction of temperature is related to flow rate.

12. What is the use of thermometer and pyrometer? ?(MAY/JUNE2014)

Thermometer is used to measure the absolute temperatures. The pyrometer is used to measure high temperatures.

13. Name the instruments used for measurement of torque. ?(MAY/JUNE2014)

- Mechanical torsion meter (Stroboscopic method).

<ul style="list-style-type: none"> • Optical torsion meter. • Electrical torsion meter. • Strain gauge torsion meter.
<p>14. classify the types of strain gauges.</p> <ul style="list-style-type: none"> • Unbonded strain gauge. • Bonded strain gauge. • Fine wire strain gauge. • Metal foil strain gauge. • Piezo-resistive strain gauge.
<p>15. Mention a few materials used in binding of strain gauges. (NOV/DEC 2013)</p> <ul style="list-style-type: none"> • Ceramic cement. • Epoxy. • Nitrocellulose.
<p>16. Mention the types of dynamometers.</p> <ul style="list-style-type: none"> • Absorption dynamometer. • Driving dynamometer. • Transmission dynamometer.
<p>17. Mention the types of electrical strain gauges. (NOV/DEC 2013)</p> <ul style="list-style-type: none"> • Inductive. • Capacitive. • Piezo electric. • Resistance types.
<p>18. mention the uses of rotometer, hotwire anemometer.?(MAY/JUNE2014) Both are used to measure flow rate.</p>
<p>19. Give any two applications of an ultrasonic flow meter.</p> <ul style="list-style-type: none"> • Measurement of flow between the blades of turbines. • Remote sensing of wind velocities.
<p>20. Name any four inferential types of flow meters. (NOV/DEC 2013)</p> <ul style="list-style-type: none"> • A venturimeter. • A orifice meter. • A rotometer. • A pitot tube.
<p>21. what is the principle involved in fluid expansion thermometer? (NOV/DEC 2013) In fluid expansion thermometers, the change in pressure in the bulb is taken as an indication of the temperature.</p>
<p>PART-B (16 MARKS) DESCRIPTIVE TYPE QUESTIONS</p>
<p>1. Explain the construction and working of a Venturimeter and Rotometer? (NOV/DEC 2013)</p>
<p>2. With the neat Sketch explain how bimetallic strips are used for temperature measurement?(MAY/JUNE2012)</p>
<p>3. Explain the working and purpose of electrical resistance thermistors.(MAY/JUNE2013)</p>
<p>4. With the neat sketch explain the working of thermocouple and Pitot tube?(NOV/DEC2012)</p>

- | | |
|----|--|
| 5. | With the neat sketch explain the Torque measurement using Strain Gauges and Hydraulic Dynamometer?(MAY/JUNE2014) |
| 6. | With the neat sketch explain the velocity measurement using hot wire anemometer?(NOV/DEC 2013) |
| | |

DOM QUESTION BANK

UNIT I FORCE ANALYSIS

Dynamic force analysis – Inertia force and Inertia torque– D Alembert's principle –Dynamic Analysis in reciprocating engines – Gas forces – Inertia effect of connecting rod– Bearing loads – Crank shaft torque – Turning moment diagrams –Fly Wheels – Flywheels of punching presses- Dynamics of Cam follower mechanism.

PART-A

1. Define free body diagram

(AU Jun 2009, May 2005)

A free body diagram is a sketch of the isolated or free body which shows all the pertinent weight forces, the externally applied loads, and the reaction from its supports and connections acting upon it by the removed elements.

2. What are the conditions for a body to be in static and dynamic equilibrium?

(AU Jun 2006)

Necessary conditions for static and dynamic equilibrium are

- i) Vector sum of all forces acting on a body is zero.
- ii) The vector sum of the moments of all forces acting about any arbitrary point or axis is zero.

3. Define static force analysis.

(AU May 2012, 2013)

If components of a machine accelerate, inertia is produced due to their masses. However, the magnitudes of these forces are small compared to the externally applied loads. Hence inertia effects due to masses are neglected. Such an analysis is known as static force analysis.

4. Define Dynamic force analysis.

(AU May 2012)

If components of a machine accelerate by the applied forces (F), inertia force (-ma) is produced due to their masses. Even though the magnitudes of these forces are small as compared to the externally applied loads, if we do force analysis of machine considering the inertia forces in addition to all applied forces, then the force analysis is called Dynamic force analysis.

5. When will the two force member is in equilibrium?

(AU May 2014)

The member under the action of two force will be in equilibrium if

- i) The two forces are of same magnitude.
- ii) The forces act along the same line.
- iii) The forces are in opposite direction.

6. Give any three advantages of free body diagrams.

- i. Free body diagram assist in seeing and understanding all aspects of problem.
- ii. They help in planning the approach to the problem.
- iii. They make mathematical relations easier to the problem.

7. When will the three force member is in equilibrium?

i) A body or member will be in equilibrium under the action of three forces if the resultant of the forces is zero, and ii) the line of action of the forces intersect at a point

8. State D'Alembert's principle. (AU Dec 2006, 2011, 2015, May 2016)

- i) It states that the inertia forces and torques, and the external forces and torques acting on a body together result in static equilibrium.
- ii) In other words, the vector sum of all external forces and inertia forces acting upon a system of rigid bodies is also separately zero.

9. What is meant by turning moment diagram or crank effort diagram?

- a. It is the graphical representation of the turning moment or crank effort for various position of the crank.
- b. In turning moment diagram, the turning moment is taken as the ordinate (y-axis) and crank angle as abscissa (x-axis).

10. Differentiate between static force analysis and dynamic force analysis.

Static force analysis:

If components of a machine accelerate, inertia is produced due to their masses. However, the magnitudes of these forces are small compared to the externally applied loads. Hence inertia effects due to masses are neglected. Such an analysis is known as static force analysis.

Dynamic force analysis:

If the inertia effect due to the mass of the component is also considered, it is called dynamic force analysis.

11. What are the forces acting on the connecting rod?

- a. Inertia force of the reciprocating parts acting along the line of stroke
- b. The side thrust between the cross head and the guide bars acting at P and right angles to line of stroke
- c. Weight of the connecting rod
- d. Inertia force of the connecting rod
- e. The radial force parallel to crank, and
- f. The tangential force acting perpendicular to crank.

12. State the principle of virtual work. (AU May 2015)

It states that if a system is in equilibrium and undergoes an infinitesimal displacement from its equilibrium position without any lapse of time then the net work done is equal to zero.

13. State the principle of superposition. (AU May 2013)

It states that in linear systems, if a number of forces act on a member, the net effect is equal to the superposition of the effects of the individual forces taken one at a time.

14. Define Inertia forces. (AU Dec 2004, Apr 2015)

The inertia force is an imaginary force, which when acts upon a rigid body, brings it in an equilibrium position.

- i. Inertia force = -Accelerating force = m.a.

15. Define constraint force

It is a pull or push, which acts on a body changes or tends to change, the state of rest or of uniform motion of the body. A force is completely characterized by its point of application, its magnitude and direction.

16. What is meant by correction couple?

If the two masses are placed arbitrarily in a rigid body, an error in torque is introduced. To make the

system dynamically equivalent a couple should be applied. This couple is called correction couple. The value of correction couple is always positive and its direction will be the same as that of angular acceleration ' α '.

17.Explain the term Maximum Fluctuation of Energy. (AU Dec 2003)

The difference between the maximum and minimum energies is known as the maximum fluctuation of energy.

18.Define 'Inertia Torque'.

The inertia torque is an imaginary torque, which when applied upon the rigid body, brings it in an equilibrium position. It is equal to the accelerating couple in magnitude but opposite in direction.

19.Define 'Coefficient of Fluctuation of Energy'. (AU Dec 2015, May 2014)

It is defined as the ratio between the maximum fluctuation of energy (ΔE) and the work done per cycle.

$$C_E = \Delta E / \text{Work done per cycle}$$

20.Define 'Coefficient of Fluctuation of Speed'. (AU May 2014)

It is defined as the ratio of maximum fluctuation speed to the mean speed.

$$C_S = (N_1 - N_2) / N$$

where,

N_1 & N_2 - Maximum & Minimum speed in rpm

N - Mean Speed in rpm - $(N_1 + N_2) / 2$

21.Define Coefficient of Steadiness.

The reciprocal of the coefficient of fluctuation of speed is known as Coefficient of steadiness. $m = 1 / C_S$

22.How you will reduce a dynamic analysis problem into an equivalent problem of static equilibrium?

By applying D'Alembert's principle ($\Sigma F + (-ma) = 0, \Sigma T + (-I\alpha) = 0$) to a dynamic analysis problem, we can reduce into an equivalent problem of static equilibrium.

23.What do you mean by Equivalent offset inertia force?

Equivalent offset inertia force is the force which can replace both inertia force and inertia torque.

24.What do you mean by crank effort or turning moment on the crank shaft?

It is the product of the crank-pin effort (F_T) and crank pin radius (r). $T = F_T * r$

25.What do you understand by the fluctuation of energy in Fly wheel?

The difference between the maximum and the minimum energies in Turning moment diagram is known as *Fluctuation of energy*.

26.Define shaking force. (AU Nov 2013)

A net unbalanced force acting on the frame of machine or mechanism is known as shaking force

27.Differentiate the function of flywheel and governor. (AU Dec 2012,2011)

S.No	Flywheel	Governor
1	Flywheel used is to reduce the fluctuation of speed during a cycle above and below the mean value for constant load from prime mover	Governor is used to control the mean speed over a period for output load variations
2	Flywheel works continuously from cycle to cycle	Governor works intermittently, i.e. only when there is change in the load.
3	Flywheel has no influence on mean speed of the prime mover	Governor has no influence over cycle speed fluctuations.

28.What is meant by piston efforts and crank efforts.(AU Dec 2012,2013, May 2016)

Piston effort: it is the net force applied on the piston along the line of stroke.

Crank effort: it is the net force applied on the crank pin perpendicular to the crank which gives the required turning moment on the crank shafts.

29.List out the few machines in which flywheel are used.

1.Punching machines

2.Shearing machines

3.Riveting machines

4.Crushing machines.

30.What does ‘float’ or jump of a follower?

The stored energy in a camshaft due to windup phenomenon which occurs because of variations in torque gets released at the end of follower rise. This results in undue variation of velocity and acceleration of the follower. This phenomenon is called ‘Jump’ or ‘Float’

31.Why smaller fly wheels are used in multi cylinder engines?

In multi cylinder engine more than one power stroke is produced per second. So the need to store energy in flywheel is lesser than single cylinder engines. This leads to smaller flywheel for multi cylinder engines.

32.Why negative loops are formed in turning moment diagrams?

During strokes other than power stroke, flywheel losses energy, negative loops are formed in turning moment diagram. This indicates more energy than produced is being taken from flywheel to do work absorbing processes.

33.What is the function of a fly wheel in engines? (AU Dec 2011, 2012, 2014)

Fly wheel acts as a reservoir. It absorbs some portion of energy while power stroke and delivers it in all other strokes in an Engine.

PART-B

1. A petrol engine has a stroke of 120 mm and connecting rod is 3 times the crank length. The crank rotates at 1500 rpm clockwise direction. Determine 1. Velocity and acceleration of the piston and 2. Angular velocity and angular acceleration of the connecting rod, when the piston has traveled one-fourth of its stroke from I.D.C. (Dec 2003)

Refer: “Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No:528

2The ratio of the connecting rod length to crank length for a vertical petrol engine is 4:1. The bore/stroke is 80/100 mm and mass of the reciprocating part is 1 kg. The gas pressure on the piston is 0.7 N/mm² when it has moved 10 mm from TDC on its power stroke. Determine the net load on the gudgeon pin. The engine runs at 1800 rpm at what engine speed will this load be zero. (Nov

2007)Refer: “Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 537

3The turning moment diagram for a four stroke gas engine may be assumed for simplicity to be represented by four triangles, the areas of which from the line of zero pressure are as follows: Expansion stroke = 3550 mm²; Exhaust stroke = 500 mm²; Suction stroke = 350 mm²; and compression stroke = 1400 mm². each mm² represents 3 N-m. Assuming the resisting moment to be uniform, find the mass of the rim of a fly wheel required to keep the mean speed 200 rpm within $\pm 2\%$. The mean radius of the rim may be taken as 0.75 m. Also determine the crank positions for the maximum and minimum speeds. (Dec 2010)

Refer: “Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 584

4. During a trial on steam engine it is found that the acceleration of the piston is 36m/s^2 when the crank has moved 30° from the inner dead center position. The net effective steam pressure on the piston is 0.5MPa and the frictional resistance is equivalent to force of 600 N , the diameter of the piston is 300 mm and the mass of the reciprocating parts is 180 kg . If the length of the crank is 300 mm and the ratio of the connecting rod length is 4.5 find (i) reaction on the guide bars (ii) thrust on the crank shafts bearings (iii) turning moment on the crank shaft. (Nov 2015)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 536

5. A single cylinder double acting steam engine develops 150 kW at mean speed of 80 rpm . The coefficient of fluctuations of energy is 0.1 and the fluctuations of speed are $\pm 2\%$ of mean speed. If the mean diameter of the flywheel rim is 2m and the hub and spokes provide 5% of the rotational inertia of the flywheel. Find the mass and cross sectional area of the flywheel rim. Assume density of the flywheel material (cast iron) as 7200 kg/ m^3 . (Nov 2015)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 594

6. (i) Derive the equation of force on the reciprocating parts of an engine, neglecting the weight of the connecting rod

(ii) What is turning moment diagram and draw it four stroke IC engine? (Nov-2013)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:529,567

UNIT II BALANCING

Static and dynamic balancing – Balancing of rotating masses – Balancing a single cylinder engine – Balancing of Multi-cylinder inline, V-engines – Partial balancing in engines – Balancing of linkages – Balancing machines-Field balancing of discs and rotors.

PART-A

1. What is meant by balancing?

(AU Nov 2013)

Balancing is the process of designing or modifying machinery so that unbalance is reduced to an acceptable level and if possible is eliminated entirely.

2. Write the importance of balancing.

If the moving part of a machine are not balanced completely then the inertia forces are set up which may cause excessive noise, vibration, wear and tear of the system. So, balancing of machine is necessary.

3. Mention any two practical examples of balancing.

The practical examples for balancing are

1. Automobile wheels
2. Watch needles

4. Write different types of balancing.

- i) Balancing of rotating masses
 - (a) Static balancing
 - (b) Dynamic balancing
- ii) Balancing of reciprocating masses.

5. What is static balancing?

(AU Dec 2015, May 2016)

A system of rotating masses is said to be in static balance if the combined mass centre of the system lies on the axis rotation.

6. State the condition for static balancing.

(AU Nov 2011, May 2016)

The net dynamic force acting on the shaft is equal to zero or the centre of the masses of the system must lie on the axis of rotation.

7. What is dynamic balancing?

(AU Jun 2009)

A system of rotating masses is said to be in dynamic balance if there does not exist any resultant centrifugal force as well as resultant couple.

8. Write the conditions for complete balancing. (AU May 2014)

- a. The resultant centrifugal force must be zero
- b. The resultant couple must be zero.

9. State the condition for dynamic balancing. (AU Nov 2011, 2012)

Condition for dynamic balancing

- a. The net dynamic force acting on the shaft is equal to zero or the centre of the masses of the system must lie on the axis of rotation.
- b. The net couple due to the dynamic force acting on the shaft is equal to zero or the algebraic sum of the moments about any point in the plane must be zero.

10. What do you understand by the term *partial balancing*? (AU Dec 2003)

In a reciprocating engine, the provision of a rotating counter mass results in only a partial balance, as one vertical component of rotating mass remains unchecked. This is called partial balancing.

11. What is the effect of unbalanced primary force in a twin cylinder locomotive?

The unbalanced primary force along the line of stroke results in

- a. Variation of tractive force
- b. Swaying couple.

The unbalanced primary force perpendicular to the line of stroke results in pressure variations leading to *hammer blow*

12. Define Tractive force. (AU May 2014) In a twin cylinder locomotive, the resultant unbalanced primary force due to both the cylinders, acting along the line of stroke is known as Tractive force.

13. Whether grinding wheels are balanced or not? If so why?

Yes, the grinding wheels are properly balanced by inserting some low density materials. If not, the required surface finish won't be attained and the vibration will cause much noise.

14. Whether grinding wheels are balanced or not? If so why?

Yes, the grinding wheels are properly balanced by inserting some low density materials. If not, the required surface finish won't be attained and the vibration will cause much noise.

15. Why complete balancing is not possible in reciprocating engine? (AU May 2012 2013)

Balancing of reciprocating masses is done by introducing the balancing mass opposite to the crank. The vertical component of the dynamic force of this balancing mass gives rise to "Hammer blow". In order to reduce the Hammer blow, a part of the reciprocating mass is balanced. Hence complete balancing is not possible in reciprocating engines.

16. Differentiate between the unbalanced force due to a reciprocating mass and that due to a revolving masses.

- i. Complete balancing of revolving mass can be possible. But fraction of reciprocating mass only balanced.
- ii. The unbalanced force due to reciprocating mass varies in magnitude but constant in direction. But in the case of revolving masses, the unbalanced force is constant in magnitude but varies in direction.

17. What are the conditions required for complete balancing of reciprocating parts? (AU Nov 2014)

- i. Primary and secondary force polygon must be closed
- ii. Primary and secondary couple polygon must be closed

18. What are the effects of an unbalanced primary force along the line of stroke of two cylinder locomotive?

- i) Variation in Tractive force along the line of stroke, and
- ii. Swaying couple.
- iii) Hammer Blow

19. What is swaying couple? (AU Nov 2014)

<p>The unbalanced force acting at a distance between the line of stroke of two cylinders, constitute a couple in the horizontal direction. This couple is known as swaying couple</p>
<p>20.What are in-line engines? Multi-cylinder engines with the cylinder centre lines in the same plane and on the same side of the centre line of the crank shaft, are known as in-line engine.</p>
<p>21.What are the condition to be satisfied for complete balance of in-line engine? i. The algebraic sum of the primary and secondary forces must be zero, and ii. The algebraic sum of the couples due to primary and secondary forces must be zero.</p>
<p>22.What are balancing machines? (AU May 2003) Balancing machines are the “The machines which is used to determine whether the rotating parts of a machine is completely balanced or not, to check the static and dynamic balancing of rotating parts and to determine the extent to which balancing is done.</p>
<p>23.How the different masses rotating in different planes are balanced? (AU Nov 2014) The resultant centrifugal force must be equal to zero and the resultant couple must be zero.</p>
<p>24.State the reason for positioning the cranks of a locomotive at right angles. The reason for positioning the cranks of a locomotive at right angles it will even out the turning moment.</p>
<p>25.Give the different types of balancing machines used in practice. The types of balancing machines are i. Static balancing machines ii. Dynamic balancing machines iii. Universal balancing machines</p>
<p>26.Why the cranks of a locomotive are generally at right angles to one another? In order to facilitate the starting of locomotive in any position (i.e., in order to have uniformity in turning moment) the cranks of a locomotive are generally at 90° to one another.</p>
<p>27.What is the effect of hammer blow and what is the cause of it?(AU Nov 2012, 2013, May 2004, 2013, 2016) The effect of hammer blow is to cause the variation in pressure between the wheel and the rail, such that vehicle vibrates vigorously. Hammer blow is caused due to the effect of unbalanced primary force acting perpendicular to the line of stroke.</p>
<p>28.Write short notes on balancing of linkages. Linkages are balanced by balancing the shaking force and shaking moment. In force balancing, the total mass centre is to be made stationary.</p>
<p>29.Why radial engines are preferred? In radial engines the connecting rods are connected to a common crank and hence the plane of rotation of the various cranks is same, therefore there are no unbalanced primary or Secondary couples. Hence radial engines are preferred.</p>
<p>30.What are the effects of an unbalanced primary force along the line of stroke of two cylinder locomotive? a. Variation in tractive force along the line of stroke, and (b) Swaying couple.</p>
<p>31.Can a single cylinder engine be fully balanced? Why? (AU Jun 2006) No, A single cylinder engine cannot be fully balanced. It is considered as a reciprocating mass. Balancing of reciprocating masses is done by introducing the balancing mass opposite to the crank. The vertical component of the dynamic force of this balancing mass gives rise to “Hammer blow”. In order to reduce the Hammer blow, a part of the reciprocating mass is balanced. Hence complete balancing is not possible in reciprocating engines.</p>
<p>32.Differentiate coupled and uncoupled locomotives. If two or more pairs of wheels are coupled together, the locomotives are of coupled type. Whereas, if there is</p>

only one pair of driving wheel, the locomotives are uncoupled type.

33. Write any two advantages of coupling the wheels of a coupled locomotive.

- a) The wheel resistance against slipping on the rails is increased.
- b) The hammer blow effect is minimized.

34. What is the difference between balancing of rotating & reciprocating masses.

S.No.	Balancing of Rotating Masses.	Balancing of Reciprocating Masses.
1.	Unbalanced force remains constant in magnitude, but varies in direction.	Unbalanced force remains constant in direction, but varies in magnitude.
2.	Complete balancing is possible.	Only partial balancing is possible.

35. What do you mean by the term 'shaking force' and 'shaking moment'? (AU May 2013)

Shaking forces are the forces transmitted to the foundation or frame of a machine owing to the inertia of the moving parts. The variation of these forces tends to shake or vibrate the machine causing shaking forces and shaking moments.

PART-B & PART-C

1. Three masses are attached to a shaft as follows: 10 kg at 90 mm radius, 15 kg at 120 mm radius and 9 kg at 150 mm radius. The masses are to be arranged so that the shaft is in complete balance. Determine the angular position of masses relative to 10 kg mass. All the masses are in the same (June 2014) Refer:

“Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 839

2. A, B, C and D are four masses carried by a rotating shaft at radii 100, 125, 200 and 150 mm respectively. The planes in which the masses revolve are spaced 600 mm apart and the mass of B, C and D are 10 kg, 5 kg and 4 kg respectively. Find the required mass a and the relative angular setting of the four masses so that the shaft shall be in complete balance. (Dec 2015)

Refer: “Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 845

3. A 90°-V engine has two cylinders which are placed symmetrically. The two connecting rods operate a common crank. The length of connecting rods is 320 mm each and crank radius of 80 mm. The reciprocating mass per cylinder is 12 kg. If the engine speed is 600 rpm, then find the resultant primary and resultant secondary forces. Also find the maximum resultant secondary force. (Dec 2015)

Refer: “Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 903

4. The axes of the three cylinder air compressor are 120° to one another and their connecting rods are coupled to a single crank. The length of each connecting rod is 240 mm and the stroke is 160 mm. The reciprocating parts have a mass of 2.4 kg per cylinder. Determine the primary and secondary forces if the engine runs at 2000 rpm. (Dec 2013)

Refer: “Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 896

5. A shaft has three eccentrics, each 75 mm diameter and 25 mm thick, machined in one piece with the shaft. The central planes of the eccentric are 60 mm apart. The distance of the centers from the axis of

rotation are 12 mm, 18 mm and 12 mm and their angular positions are 120° apart. The density of metal is 700 kg/m^3 . Find the amount of out-of-balance force and couple at 600 rpm. If the shaft is balanced by adding two masses at a radius 75 mm and at distance of 100 mm from the central plane of the middle eccentric, find the amount of the masses and their angular positions. (May 2012) Refer:

“Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No:850

6. The cranks of a three-cylinder locomotive are set at 120° . The reciprocating masses are 450 kg for the inside cylinder and 390 kg for each outside cylinder. The pitch of the cylinder is 1.2 m and the stroke of each piston 500 mm. The planes of rotation of the balance masses are 960 mm from the inside cylinder. If 40% of the reciprocating masses are to be balanced, determine

1. The magnitude and the position of the balancing masses required at a radial distance of 500 mm; and
2. The hammer blow per wheel when the axle rotates at 350 rpm. (May 2012)

Refer: “Khurmi, R.S.,” Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No:867

UNIT III SINGLE DEGREE FREE VIBRATION

Basic features of vibratory systems – Degrees of freedom – single degree of freedom – Free vibration – Equations of motion – Natural frequency – Types of Damping – Damped vibration – Torsional vibration of shaft – Critical speeds of shafts – Torsional vibration – Two and three rotor torsional systems.

PART-A

1. Define vibration.

Any motion that exactly repeats itself after an interval, of time is a periodic motion and is called a vibration. Generally mechanical system must have elasticity in order to support vibration

2. Vibration can have desirable effects – justify. (AU Nov 2014)

Though vibration is mainly known for its undesirable effects like, unwanted noise and wear, sometimes it is used to design a machine with a specific application. Vibratory conveyor and cell phones are example in support of the statement.

3. How do you classify vibration? (or) What are the different types of vibrations? (AU May 2003, 2016)

- a. According to the actuating force:
 - i. Free vibrations
 - ii. Forced vibrations
- b. According to energy dissipation:
 - i. Undamped vibration
 - ii. Damped vibration
- c. According to behaviour of vibrating system:
 - i. Linear vibration
 - ii. Non - linear vibration
- d. According to motion of system w.r.t. axis:
 - i. Longitudinal vibration
 - ii. Transverse vibration
 - iii. Torsional vibration

4. What is meant by free vibration? (AU May 2013)

When no external force acts on the body, after giving it an initial displacement, then the body is said to be

under free or natural vibrations.	
5.What do you meant by damping and damped vibration?	(AU May 2013)
<u>Damping:</u> The resistance against the vibration is called damping. <u>Damped vibration:</u> When there is a reduction in amplitude over every cycle of vibration, then the motion is said to be damped vibration.	
6.Define followings.	(AU May 2003)
a. Period b. Cycle c. Frequency Period -It is the time taken by a motion to repeat itself, and is measured in seconds. Cycle - It is the motion completed during one time period. Frequency - It is the number of cycles described in one second	
7.Define followings.	(AU May 2003, 2015)
a. Frequency b. Resonance c. Amplitude Frequency Frequency is the number of cycles of motion completed in one second. It is expressed in Hertz (Hz) and is equal to none cycle per second. Resonance When the frequency of the external force is the same as that of the natural frequency of the system, a state of resonance is said to have been reached. Resonance results in large amplitudes of vibrations and this may be dangerous. Amplitude – The maximum displacement of a vibrating body from the mean position	
8.What do you mean by a degree of freedom or movability?	(AU May 2003)
The number of independent coordinates required to completely define the motion of a system is known as degree of freedom of the system.	
9.Define steady state and transient state vibrations.	
In ideal systems, the free vibration continues indefinitely as there is no damping. Such vibration is termed as Steady state vibrations. In real systems, the amplitude of vibration decays continuously because of natural damping and vanishes finally. Such vibration in real system is called Transient vibration.	
10.What do you mean by the term – Equivalent spring stiffness?	
Equivalent spring stiffness is a measure of overall spring stiffness of a mechanical system having two or more springs connected in series or parallel.	
11.List out the various methods of finding the natural frequency of free longitudinal vibrations.	
1. Energy method 2. Equilibrium method and 3. Rayleigh’s method.	
12.Distinguish between critical damping and large damping.	(AU May 2008)
If system is critically damped, the mass moves back very quickly to its equilibrium position within no time. Whereas in large damping, the mass moves slowly to the equilibrium position.	
13.When do you say a vibrating system is under damped?	(AU Nov 2015)
The equation of motion of a free damped vibration is given by $\frac{d^2x}{dt^2} + \frac{c}{m} \frac{dx}{dt} + \frac{s}{m} x = 0$ If $(s/m) > (c/2m)^2$, then radical becomes negative. The two roots k_1 and k_2 are known as complex conjugate. Then the vibrating system is known as under damping.	
14.Write the expression for the estimation of the natural frequency of free torsional vibration of a shaft.	(AU Nov 2015)
$f_n = 1/t_p = 1/2\pi \sqrt{q/I}$	
15.Define Vibration Isolation.	(AU May 2013)

The process of reducing the vibrations of machines using vibration isolating materials is called vibration isolation.

16. What is the principle of Rayleigh's method of finding natural frequency of vibrations? (AU May 2014)

The principle of Rayleigh's method is "the maximum kinetic energy at the mean position is equal to the maximum potential energy at the extreme position".

17. Define critical or whirling or whipping speed of a shaft.

The speed at which resonance occurs is called critical speed of the shaft. In other words, the speed at which the shaft runs so that the additional deflection of the shaft from the axis of rotation becomes infinite is known as critical speed.

18. What are the factors that affect the critical speed of a shaft? (AU Jun 2007)

The critical speed essentially depends on

- i) The eccentricity of the C.G of the rotating masses from the axis of rotation of the shaft.
- ii) Type of supports connections at its ends.
- iii) Diameter of the disc
- iv) Span of the shaft

19. What are the causes of critical speed?

- a. Eccentric mountings,
- b. Bending due to self weight, and
- c. Non-uniform distribution of rotor material

20. Define Damping ratio. (AU May 2014, Nov 2013)

It is defined as the ratio of actual damping coefficient(c) to the critical damping coefficient(c_c).
Mathematically, Damping ratio, $\zeta = C / C_c = C / (2m\omega_n)$.

21. Define logarithmic decrement. (AU May 2003, 2014, 2016, Nov 2012, 2014)

Logarithmic decrement is defined as the natural logarithm of the amplitude reduction factor. The amplitude reduction factor is the ratio of any two successive amplitudes on the same side of the mean position.

$$\delta = \log_e (x_1/x_2) = \log_e (x_n/x_{n+1})$$

22. What do you know about inertia effect of the mass of spring in longitudinal vibration (AU May 2016)

If the effect of inertia due to mass of the spring is taken into account, The inertia effect of the spring is equal to that of a mass one third of the mass of the spring, concentrated at its free end.

23. In a geared system, what assumptions to be made before replacing it with an equivalent system.

- i. Inertia of the gear and shafts are negligible.
- ii. Loading is within the elastic limits.
- iii. No backlash or slip occurs in the gear drive.

24. What is the condition of a system to vibrate?

For a system to vibrate, it must possess inertial and restoring elements, whereas it may possess some damping element responsible for dissipating the energy.

25. What is harmonic forcing?

In spring mass system, if the resultant motion is the sum of two harmonics, then it is said to be Harmonic forcing.

26. What is meant by periodic forcing?

A periodic force is one in which the motion repeats itself in all details after a certain interval of time.

27. What is the response of the complete periodic forcing?

The response of the complete periodic forcing is the vector sum of the responses to the complimentary functions and particular solutions of the individual forcing functions as on the right hand side of the equation.

28.What is Forced- Damped vibrations?

If in a spring mass system, Damping is also provided with a dashpot means, the system is called as forced-damped vibration system.

29.What all are the factors upon which the magnification factor depends on?

Magnification factor depends on the following factor,

1. The ratio of frequencies, ω/ω_n
2. The damping factor.

30.When will the maximum amplitude of vibration occur?

Irrespective of the amount of damping, the maximum amplitude of vibration occurs before the ratio ω/ω_n reaches unity or when the frequency of the forced vibration is less than that of the un damped vibration.

31.In a system the dampers should not be used, When?

In a system where ω/ω_n can vary from zero to higher values, dampers should not be used. Instead stops may be provided to limit the resonance amplitude.

PART-B& PART-C

1.Determine the equivalent spring stiffness and the natural frequency of the following vibrating systems when

- a) the mass is suspended to a spring
- b) the mass is suspended at the bottom of two springs in series
- c) the mass is fixed in between two springs
- d) the mass is fixed to the midpoint of a spring

(Dec 2012)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:911

2. A vibrating system consists of a mass of 50 kg, a spring of stiffness 30 kN/m and a damper. The damping provided is only 20 % of the critical value. Determine

1. the damping factor
2. the critical damping coefficient
3. the natural frequency of damped vibrations
4. the logarithmic decrement
5. the ratio of two consecutive amplitudes.

(Nov 2014)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:937

3. The machine mounted on springs and fitted with a dashpot has a mass of 60 kg. There are three springs, each of stiffness 12 N/mm. The amplitude of vibrations reduces from 45 to 8 mm in two complete oscillations. Assuming that the damping force varies as the velocity, determine

- i) the damping coefficient,
- ii) the ratio of frequencies of damped and undamped vibrations, and
- iii) the periodic time of damped vibrations.

(May 2013)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:947

4. Determine the (i) the critical damping co-efficient (ii) the damping factor, (iii) the natural frequency of damped vibrations (iv) the logarithmic decrement and (v) the ratio of two consecutive amplitudes of a vibrating system which consists of a mass of 25 kg, a spring of stiffness 15 kN/m and a damper. The damping provided is only 15 % of the critical value. (Nov 2015)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:948

5. A shaft of length 1.25 m is 75 mm in diameter for the first 275 mm of its length, 125 mm in diameter for the next 500 mm length, 87.5 mm in diameter for the next 375 mm length and 175 mm in diameter for the remaining 100mm of its length. The shaft carries two rotors at two ends. The mass moment of inertia of the first rotor is 75 kg-m² whereas of the second rotor is 50 kg-m². Find the frequency of natural torsional vibrations of the system. The modulus of rigidity of the shaft material may be taken as 80 Gpa. (Nov 2015)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:983

6. (i) A machine weighs 18 kg and is supported on spring and dashpots. The total of the spring is 12 N/mm and damping is 0.2 N/mm/s. the system is initially at rest and a velocity of 120 mm/s is imported to the mass. Determine (i) the displacement and velocity of mass as a function of time, and the displacement velocity after 0.4 sec

(ii) Describe the types of vibrations with simple sketch. (Nov 2013)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:949

UNIT IV FORCED VIBRATION

Response of one degree freedom systems to periodic forcing – Harmonic disturbances –Disturbance caused by unbalance – Support motion –transmissibility – Vibration isolation vibration measurement.

PART-A

1. What is meant by Forced vibrations? (AU Nov 2011)

When the body vibrates under the influence of external force, then the body is said to be under forced vibrations.

2. Define Torsional vibration.

Torsional vibration of a shaft or a disc is the alternate twisting and untwisting of the rotating material. In this kind the particles move in a circle about the axis.

3. Differentiate between transverse and torsional vibration.

- i. In transverse vibrations, the particles of the shaft move approximately perpendicular to the axis of the shaft. But in torsional vibrations, the particles of the shaft move in a circle about the axis of the shaft.
- ii. Due to transverse vibrations, tensile and compressive stresses are induced.
- iii. Due to torsional vibrations, torsional shear stresses are induced in the shaft.

4. What is meant by dynamic magnifier or magnification factor? (AU Dec 2004)

It is the ratio of maximum displacement of the forced vibration to the deflection due to the static force.

5. Define torsional equivalent shaft.

A shaft having variable diameter for different lengths can be theoretically replaced by an equivalent shaft of uniform diameter such that they have the same total angle of twist when equal opposing torques are applied at their ends. Such a theoretically replaced shaft is known as torsionally equivalent shaft.

6 Define transmissibility ratio or isolation factor.	(AU May 2008)
The ratio of force transmitted to the force applied is known as transmissibility ratio.	
7. Briefly explain elastic suspension.	
When machine components are suspended from elastic members, the vibrational force produced by the machine components will not be transmitted to the foundation. This is called as elastic suspension.	
8. What are the methods of isolating the vibration?	(AU June 2006)
i. High speed engines/machines mounted on foundation and supports cause vibrations of excessive amplitude because of the unbalanced forces. It can be minimized providing spring-damper, etc. ii. The materials used for vibration isolation are rubber, felt cork, etc. These are placed between the foundation and vibrating body	
9. Specify any two industrial application where the transmissibility effects of vibration are important.	
i. All machine tools, and ii. All turbo machines.	
10. Define node in torsional vibration.	(AU Dec2013)
Node is the point or the section of the shaft at which amplitude of the torsional vibration is zero. At nodes, the shaft remains unaffected by the vibration.	
11. What is free torsional vibration of a single rotor system?	
In single rotor system the shaft is assumed to be massless. If the disc is given a twist about its vertical axis and then released, it will start oscillating about the axis and will perform torsional vibrations.	
12. What do you know by multifilar systems?	
Multifilar systems are used to determine the moment of inertia of irregular bodies such as unsymmetrical castings, connecting rods, ect. For which it is quite difficult to find their moment of inertia from their dimensions.	
13 What is bifilar suspension?	
If a disc of mass is suspended from a rigid support with the help of two cords, that system is said to be a <i>bifilar suspension</i> . If the disc turned through a small angle, on release, the disc will oscillate about the vertical axis and execute a torsional vibration.	
14. What is Trifilar suspension?	
If a disc of mass is suspended from a rigid support with the help of three vertical cords, that system is said to be a <i>Triifilar suspension</i> system.	
15. Explain briefly about free torsional vibrations in a Two – Rotor system.	
If a shaft held in bearings carries a rotor at each end, it can vibrate torsionally such that the two rotors move in the opposite directions. Thus, some length of the shaft is twisted in the other.	
16.Explain briefly about free torsional vibrations in a Three – Rotor system.	
In a three – rotor system, two rotors A and B are fixed to the ends of the shaft, and the rotor C is in between those.	
17 What do you understand by two – node frequency?	
One set of values given by the quadratic equation gives the position of two nodes and the frequency thus obtained is known as <i>two – node frequency</i> .	
18.What do you understand by single – node frequency?	
In the other set of values, one gives the position of a single node and the other is beyond the physical limits of the equation. The frequency so obtained is known as <i>single – node frequency</i> .	
19. How will you find the frequency of rotors are fixed to a shaft of various diameters at different sections?	
The most convenient manner of finding frequency of rotors are fixed to a shaft of various diameters at different sections is by replacing the shaft with a torsionally equivalent shaft having a suitable diameter.	

20. Write down the assumptions in the geared system to be replaced by an equivalent shaft system?

The assumptions are

- i. The inertia of the gears and shafts are negligible
- ii. The load is within elastic limits of gear teeth
- iii. No backlash or slip occurs in the gear drive.

21. What is meant by dynamic magnifier or magnification factor? (AU Nov 2014, May 2014, 2016)

It is the ratio of maximum displacement of the forced vibration (x_{\max}) to the deflection due to the static force F (x_0).

$$D = x_{\max} / x_0$$

22. What is meant by "Transmissibility"? (AU May 2005, 2012, 2014, Nov 2013, 2014)

When a machine is supported by a spring, the spring transmits the force applied on the machine to the fixed support or foundation. This is called as transmissibility.

23. A vibrating system consists of a mass of 7Kg and a spring stiffness 50N/cm and damper of damping coefficient 0.36N/cm⁻¹sec. Find damping factor.

Given data:

$$m = 7 \text{ Kg}$$

$$s = 50 \text{ N/cm} = 5000 \text{ N/m}$$

$$c = 0.36 \text{ N/cm/sec} = 36 \text{ N/m/sec}$$

Sol:

$$\omega_n = \sqrt{s/m} = \sqrt{(5000/7)} = 26.72 \text{ rad/sec}$$

$$c_c = 2m \omega_n = 2 * 7 * 26.72 = 374.16 \text{ N/m/s}$$

$$\text{Damping factor} = c / c_c = 0.0962$$

24. Briefly explain elastic suspension.

When machine components are suspended from elastic members, the vibrational force produced by the machine components will not be transmitted to the foundation. This is called as elastic suspension.

25. Specify the importance of vibration isolation?

When an unbalanced machine is installed on the foundation, it produces vibration in the foundation. So, in order to prevent these vibrations or to minimize the transmission of forces to the foundation, vibration isolation is important.

26. What are the methods of isolating the vibration?

- a. High speed engines / machines mounted on foundation and supports cause vibrations of excessive amplitude because of the unbalanced forces.
- b. The materials used for vibration isolation are rubber, felt cork, etc. These are placed between the foundation and vibrating body.

27. Define frequency response curve.

Frequency response curve is a curve drawn between magnification factor and frequency ratio (ω/ω_n) for various values of damping factor.

28. Define Damping ratio.

(AU Dec 2013)

It is defined as the ratio of actual damping coefficient (c) to the critical damping coefficient (c_c).

Mathematically,

$$\text{Damping ratio, } \zeta = c / c_c = c / (2m\omega_n).$$

29. Define Whirling speed.

(AU May 2013, Nov 2011, 2012)

It is the speed at which a rotating shaft tends to vibrate violently in the transverse direction.

30. Differentiate between transverse and torsional vibration.

- i. In transverse vibrations, the particles of the shaft move approximately perpendicular to the axis of the shaft. But in torsional vibrations, the particles of the shaft move in a circle about the axis of the shaft.
- ii. Due to transverse vibrations, tensile and compressive stresses are induced. Due to torsional vibrations, torsional shear stresses are induced in the shaft.

31. What are the conditions to be satisfied for an equivalent system to that of geared system in torsional vibrations? (AU May 2014)

- a. The kinetic energy of the equivalent system must be equal to the kinetic energy of the original system.
- b. The strain energy of the equivalent system must be equal to the strain energy of the original system.

PART-B& PART-C

1. A single cylinder vertical petrol engine has a mass of 200 kg and is mounted upon a steel chassis frame. The vertical static deflection of the frame is 2.4 mm due to the weight of the engine. The reciprocating part of the engine has a mass of 9 kg and move through a vertical stroke of 160 mm with simple harmonic motion. A dashpot with a damping coefficient of 1N/mm/s is also used to dampen the vibrations considering that the steady state of vibration is reached, determine

- (i) Amplitude of the forced vibration if the driving shaft rotates at 500 rpm**
- (ii) The speed of the driving shaft at which resonance will occur (Dec 2015)**

Refer: "Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 985

2. (i) Derive the relation for the displacement of mass from the equilibrium position of a damped vibration system with harmonic forcing

- (ii) Define the term vibrating isolation. (Dec 2013)**

Refer: "Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 972

3. (i) Discuss the forcing due to support motion.

- (ii) What is meant by magnification factor in case of forced vibrations? (Dec 2013)**

Refer: "Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 955.

4. A shaft supported freely at the ends has a mass of 120 kg placed 250 mm from one end. Determine the frequency of the natural transverse vibrations if the length of the shaft is 700 mm, $E = 200 \text{ GN/m}^2$ and shaft diameter is 40 mm. (June 2014)

Refer: "Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 920

5. A shaft 40 mm diameter and 2.5 m long has a mass of 15 kg per meter length. It is simply supported at the ends and carries three masses 90 kg, 140 kg and 60 kg at 0.8 m, 1.5 m and 2 m respectively from the left support. Taking $E = 200 \text{ GN/m}^2$, find the frequency of the transverse vibrations. (Dec 2010)
Refer: "Khurmi, R.S.," Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No: 929.

6. The following data relate to a shaft held in long bearings.

Length of shaft = 1.2 m

Diameter of shaft = 14,

Mass of a rotor at midpoint = 16 kg,

Eccentricity of centre of mass of rotor from centre of rotor = 0.4 mm

Modulus of elasticity of shaft material = 200 GN/m²

Permissible stress in shaft material = $70 \times 10^6 \text{ N/m}^2$

Determine the critical speed of the shaft and the range of speed over which it is unsafe to run the shaft.

Assume the shaft to be mass less.

(Nov 2012)

Refer: “Khurmi, R.S.,”Theory of Machines”, 14th Edition, S Chand Publications, 2005. Page No: 959

UNIT V MECHANISM FOR CONTROL

Governors – Types – Centrifugal governors – Gravity controlled and spring controlled centrifugal governors – Characteristics – Effect of friction – Controlling force curves. Gyroscopes –Gyroscopic forces and torques – Gyroscopic stabilization – Gyroscopic effects in Automobiles, ships and airplanes.

PART-A

1.Explain the function of governor.

(AU May 2005, Nov 2012)

The function of a governor is to maintain the speed of an engine within specified limits whenever there is a variation of load. Governors control the throttle valve and hence the fuels supply to cater the load variation on engines.

2.What is the principle of working of centrifugal governor? (AU Jun 2009)

The centrifugal governors are based on balancing of centrifugal force on the rotating balls by an equal and opposite radial force.

3.Differentiate between governor and flywheel?

(AU May 2003, 2015)

S.No	GOVERNOR	FLYWHEEL
1	The function of a governor is to regulate the mean speed of an engine, when there are variations in the load.	The function of a flywheel is to reduce the fluctuations of speed caused by the fluctuation of the engine turning moment during each cycle of operation.
2	It is provided on prime movers such as engines and turbines.	It is provided on engine and fabricating machines viz., rolling mills, punching machines, shear machines, presses,etc.
3	It works intermittently, i.e., only when there is change in load.	It works continuously from cycle to cycle.
4	It has no influence over cyclic speed fluctuation	It has no influence on mean speed of the prime mover.

4.What is the principle of inertia governors?

In inertia governors, the ball are so arranged that the inertia forces caused by an angular acceleration or retardation of the shaft tend to alter their positions.

5.What is equilibrium speed?

The speed at which the governor balls arms, sleeve, etc., are in complete equilibrium and there is no upward or downward movement of the sleeve on the spindle is known as equilibrium speed.

6.What is governor?

Governor is a component to regulate the mean speed of an engine, when there are variations in the load. This is done by regulating the fuel supply to the engine.

7.Explain controlling force?

An equal and opposite force to the centrifugal force acting radially inwards (i.e. centripetal force) is termed as controlling force of a governor.

8.Explain the governor effort
 The mean force acting on the sleeve for a given percentage change of speed for lift of the sleeve is known as the governor effort

9.Define power of a governor
 The power of a governor is the work done at the sleeve for a given percentage change of speed. It is the product of the mean value of the effort and the distance through which the sleeve moves.
 Power= Mean effort* Lift of sleeve.

10.Define coefficient of sensitiveness. (AU May 2008)
 It is the ratio between range of speed and mean speed.
 Range of speed N_1-N_2
 Coefficient of sensitiveness = $\frac{N_1-N_2}{\text{Mean speed}}$ = $\frac{N_1-N_2}{N}$

11.What is meant by hunting? (AU Nov 2012, 2015, May 2012, 2016)
 The phenomenon of continuous fluctuation of the engine speed above and below the mean speed is termed as hunting. This occurs in over-sensitive governors

12.Explain the term stability of the governor?
 A governor is said to be stable if there is only one radius of rotation for all equilibrium speeds of the balls within the working range. If the equilibrium speed increases the radius of governor ball must also increase.

13.Explain Isochronism. (AU May 2014)
 A governor with zero range of speed is known as an isochronous governor. Actually the isochronism is the stage of infinite sensitivity. i.e., when the equilibrium speed is constant for all radii of rotation of the balls within the working range, the governor is said to in isochronism.
 This means that the range of speed $(N_1-N_2) = 0$.
 Sensitiveness = $\frac{\text{Mean speed}}{\text{Range of speed}}$ = α

14.Explain sensitiveness of governors. (AU May, Nov 2013, 2014)
 The sensitiveness is defined as the ratio of the mean speed to the difference between the maximum and minimum speeds.
 Sensitiveness = $\frac{\text{Mean speed}}{\text{Range of speed}}$ = $\frac{N}{N_1-N_2}$ = $\frac{N}{N_1+N_2}$ = $\frac{N}{2(N_1-N_2)}$

15.Give the applications of gyroscopic principle.
 i) In instrument or toy known as gyroscope,
 ii) In ships in order to minimize the rolling and pitching effects of waves, and
 iii) In aero planes, monorail cars, gyrocompasses, etc.

16.Define steering, pitching and rolling.
Steering: It is the turning of a complete ship in a curve towards left or right, while it moves forward.
Pitching: It is the turning of a complete ship up and down in a vertical plane about transverse axis.
Rolling: It is the movement of a ship in a linear fashion.

17.What is gyroscopic Torque or couple?
 Whenever a rotating body changes its axis of rotation, a torque or couple is applied on the rotating body. This torque or couple is known as gyroscopic torque or couple.

18.Explain gyroscopic couple. (AU Nov 2005, 2011, May 2014)
 If a body having moment of inertia I and rotating about its own axis at ω rad/sec is also caused to turn at ω_p rad/sec about an axis perpendicular to axis of spin, then it experiences a gyroscopic couple of magnitude $(I \omega \omega_p)$ in an axis which is perpendicular to both the axis of spin and axis of precession.

19.What is meant by lag in response?

In any control system, there is a delay in response due to some inherent cause and it becomes difficult to measure the input and output simultaneously. This delay in response is termed as lag in response.

20.What is controlling force diagram?

When the graph is drawn between the controlling force as ordinate and radius of rotation of the balls as, the graph so obtained is called controlling force diagram.

21.Why there is no effect of the gyroscopic couple acting on the body of a ship during rolling?

We know that, for the effect of gyroscopic couple to occur, the axis of precession should always be perpendicular to the axis of spin. In case of rolling of a ship, the axis of precession is always parallel to the axis of spin for all positions. Hence there is no effect of the gyroscopic couple acting on the body of the ship during rolling.

22.What is meant by lag in response?

In any control system, there is a delay in response due to some inherent cause and it becomes difficult to measure the input and output simultaneously. This delay in response is termed as lag in response.

23.What is sleeve lift?

The sleeve lift is the vertical distance through which the sleeve is displaced due to change in equilibrium speed.

24.High sensitiveness is undesirable for a governor. Validate this statement.

If a governor is too sensitive, when the load on engine falls, the sleeve rises rapidly to a maximum position. This triggers the closure of throttle valve leading sudden fall in speed. Now the sleeve moves rapidly downwards to a minimum position. Thus the governor fluctuates continuously, which is undesirable.

25.Stability and sensitiveness are two opposite characteristics. Justify.

The balls of a stable governor should occupy the same position for each speed of the engine within the working range. This is possible only when the speed fluctuations are kept at minimum, while means when sensitiveness is lesser, thus stability and sensitiveness are opposite characteristics.

26.Mention any two advantages of using spring loaded governors in the place of gravity-controlled governors.

- i. Spring loaded governors can operate at higher speeds.
- ii. It is capable of being fixed at any inclination.

27.When the engine in the above case rotates in clockwise then what is the effect of reactive gyroscopic couple?

To raise the tail and dip the nose of the aero plane.

28.Explain the principle of gyroscope.

(AU Nov 2013)

A gyroscope is a spinning body which is free to move in other directions under the sections of external forces. Let us consider a disc rotating with uniform angular velocity in counter clockwise about its own axis called axis of spin. If it turns in a horizontal plane by rotating about a vertical axis in counter clockwise direction, then a clockwise couple will be automatically induced about the axis perpendicular to X-Y plane. This results a reactive couple due to the reaction in the bearings. The active and reactive couple constitute active and reactive gyroscopic torques.

29.When the aeroplane in the above case runs right, with other conditions kept same then what is the effect of reactive gyroscopic couple?

To raise the tail and dip the nose.

30.What is the effect of gyroscope on rolling of ship?

As the axis of rolling of the ship and the rotor are parallel, there is no effect of the gyroscopic couple.

31.Write short notes on stability of an automobile.

In case of four wheeler, stability while in motion is based on two effects.

- effect due to gyroscopic couple
- effect due to centrifugal couple.

32.State the conditions for stability of a two-wheeler.

The overturning couple due to centrifugal force should be balance by the couple due to the weight of the vehicle.

33.What are the types of Automatic control of systems?

- a. Open-loop (or) unmonitored control system
- b. Closed-loop (or) Monitored control system
- c. Continuous control system
- d. Discontinuous control system

34.What are the terminologies used in Automatic control of systems?

1. Command, 2. Response, 3. Process control, 4. Process controller, 5. Regulator, 6. Kinetic control, 7. Feedback, 8. Deviation sensor

35.What is the effect of friction on the governors?

Generally, we have assumed the governor to be frictionless. In actual practice there is always friction in the joints and operating mechanism of the governor. Since the frictional force always acts in the opposite direction to that of motion, therefore when the speed of rotation decreases, the friction prevents the downward movement of the sleeve and the radial inward movement of the balls.

PART-B& PART-C

1. Calculate the minimum speed, maximum speed and range of the speed of a porter governor, which has equal arms each 200 mm long and pivoted on the axis of rotation. The mass of each ball is 4 kg and the central mass of the sleeve is 20 kg. the radius of the rotation of the ball is 100 mm when the governor begins to lift and 130 mm when the governor is at maximum speed. (Dec 2015)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:657

2. The turbine rotor of a ship has a mass of 3500 kg. it has a radius of gyration of 0.45 m and a speed of 3000 rpm clockwise when looking from stern. Determine the gyroscopic couple and its effect upon the ship:

(i) When the ship is steering to the left on a curve of 100m radius at a speed of 36kmph

(ii) When the ship is pitching in a simple harmonic motion the bow falling with its maximum velocity the period of pitching is 40 sec and the total angular displacement between the two extreme positions of pitching is 12° (Dec 2015)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:492.

3.(i) Explain the functions of a proellgoverner with the help of a neat sketch. Derive the relationship among the various forces acting on the ling

(ii) What are the centrifugal governors? How do they differ from inertia governors?(Dec 2013)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:670,654

4.Each arm of a Porter governor is 250 mm long. The upper and lower arms are pivoted to links of 40 mm and 50 mm respectively from the axis of rotation. Each ball has a mass of 5 kg and the sleeve mass is 50 kg. The force of friction on the sleeve of the mechanism is 40 N. Determine the range of speed of the governor for extreme radii of rotation of 125 mm and 150 mm. (June 2011)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:657

5.The mass of each ball of a Proell governor is 7.5 kg and the load on the sleeve is 80 kg. Each of the arms is 300 mm long. The upper arms are pivoted on the axis of rotation whereas the lower arms are pivoted to links of 40 mm from the axis of rotation. The extensions of the lower arms to which the balls are attached are 100 mm long and are parallel to the governor axis at the minimum radius. Determine the equilibrium speeds corresponding to extreme radii of 180 mm and 240 mm. (May 2012)

Refer: "Khurmi, R.S.,"Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:670

6. In a spring loaded Hartnell type of governor, the mass of each ball is 4 kg and the lift of the sleeve is 40 mm. The governor begins to float at 200 rpm when the radius of the ball path is 90 mm. The mean working speed of the governor is 16 times the range of speed when friction is neglected. The lengths of the ball and roller arms of the bell-crank lever are 100 mm and 80 mm respectively. The pivot center and the axis of governor are 115 mm apart. Determine the initial compression of the spring, taking into account the obliquity of arms. Assuming the friction at the sleeve to be equivalent to a force of 15 N, determine the total alteration in speed before the sleeve begins to move from the mid- position (Dec 2012)

Refer: "Khurmi, R.S., "Theory of Machines", 14th Edition, S Chand Publications, 2005. Page No:678

PROFESSIONAL ETHICS QUESTION BANK

UNIT I	HUMAN VALUES
<p>Morals, values and Ethics – Integrity – Work ethic – Service learning – Civic virtue – Respect for others – Living peacefully – Caring – Sharing – Honesty – Courage – Valuing time – Cooperation – Commitment – Empathy – Self confidence – Character – Spirituality – Introduction to Yoga and meditation for professional excellence and stress management</p>	
<p>PART – A</p>	
<p>1.What are the characteristics of values?(NOV/DEC2017) Values are bipolar with a positive and a negative pole such as pleasant/painful, easy, difficult, strong, weak, rich, poor, beautiful, ugly, true, false, good, and bad</p>	
<p>2.What are the two important ways of building courage?(NOV/DEC2017) The two important ways of building courage are given below raise your consciousness move from fear to action even if you expected to fail</p>	

<p>3. Define moral values with suitable examples ?(APRIL MAY 2017) (NOV 2013) (MAY 2015) Moral values are understood to be those that make a person good purely and simply as a person They are not qualities or attributes of the person but outside his or her control</p>
<p>4. Define the term service learning ?(APRIL MAY 2017) Service learning is a teaching and learning strategy that integrates meaningful community service with instruction and reflection to enrich the learning experience teach civic responsibility and strengthen communities</p>
<p>5.what are values ?(NOV/DEC 2016) (APRIL MAY 2010)(May 2016) values are understood to be those that make a person good purely and simply as a person They are not qualities or attributes of the person but outside his or her control</p>
<p>6.what is meant by self confidence ? (May 2016) Success comes to those who dare and act it seldom comes to the timid said our former pandit Jawaharlal Nehru also we know that faith in oneself is confidence gives rise to strength and courage to the mind</p>
<p>7. Specify how the Ethics is classified? Ethics Classification are done as follows Personal , Corporate , Professional</p>
<p>8. List some of the Personal Ethics ?</p> <ul style="list-style-type: none"> • Some of the Personal Ethics are Copying of Home works and tests • Copying of video CD's • Usage of college papers for personal use • Software piracy • Income taxes
<p>9. Define the term Ethics ? (NOV 2013) Term Ethics obtained from the Greek word ethos, which means study of what is wrong and what is right (or) study of good and bad character.</p>
<p>10. Define Engineering Ethics ? (NOV 2013) Engineering Ethics is The study of the moral issues and decisions confronting individuals and organizations engaged in engineering and The study of related questions about the moral ideas, character, policies, relationship of people and corporations involved in technological activities.</p>
<p>11.Define Values. A value is defined as a principle that promotes well-being or prevents harm.</p>
<p>12.What are Personal values? Emotional beliefs in principles regarded as particularly favorable or important for the individual.</p>
<p>13.What are ethical values? Trustworthiness, respect, responsibility, fairness, caring is ethical values</p>
<p>14.List out the five core human Values. The five core human values are: (1) Right conduct, (2) Peace, (3) Truth, (4) Love, and (5) Non-violence</p>
<p>15.List out the ways in which service learning is distinguished.</p> <ul style="list-style-type: none"> • Connection to curriculum • Learner's voice • Reflection • Partners in the community
<p>16.Define Self-Assertion. Self-assertion means that citizens must be proud of their rights, and have the courage to stand up in public and defend their rights. Sometimes, a government may usurp the very rights that it was created to protect. In such cases, it is the right of the people to alter or abolish that government (e.g., voting rights, rights call back).</p>
<p>17.What are the aspects of Honesty?</p> <ul style="list-style-type: none"> • Truthfulness • Trustworthiness. <p>Truthfulness is to face the responsibilities upon telling truth. One should keep one's word or promise. But trustworthiness is maintaining integrity and taking responsibility for personal performance.</p>

<p>18. Define Courage. Courage is the tendency to accept and face risks and difficult tasks in rational ways. Self-confidence is the basic requirement to nurture courage</p>
<p>19. List out the classification of courage. Courage is classified into three types, based on the types of risks, namely</p> <ul style="list-style-type: none"> • Physical courage • Social courage • Intellectual courage.
<p>20. Define co-operation. Co-operation means extending help to others, for a good cause. Co-operation may be through an idea, a suggestion, an assistance or physical work which extends to others for common benefit</p>
<p>21. What is Commitment? Commitment means <i>alignment to goals and adherence to ethical principles during the activities</i>. First of all, one must believe in one's action performed and the expected end results (confidence). It means one should have the conviction without a bit of doubt that one will succeed.</p>
<p>22. What do you mean by the term Virtues? The moral ideals in which a profession is dedicated specify the Virtues. Virtues are the desirable features of character, which related to other individuals, group, or organizations. They have as much to do with motives, attitudes, and emotions as they do with right or wrong conduct.</p>
<p>23. List some of the Models of Professional Roles? (May 2012) Some of the Models of Professional Roles are Savior, Guardians, Bureaucratic Servant, and Social Servants, Social enabler and catalyst and Game Players.</p>
<p>24. Define empathy. Empathy means putting self in a position of someone else and thinking as the later and reasoning suitable action.</p>
<p>25. List out the benefits of empathy.</p> <ul style="list-style-type: none"> • Good customer relations (in sales and service, in partnering). • Harmonious labor relations (in manufacturing). • Good vendor-producer relationship (in partnering.)
<p>26. Define Compromise? In a negative sense it means to undetermined integrity by violating one's fundamental moral principles. In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct</p>
<p>27. Define Ethical Pluralism and Ethical Relativism? (APRIL MAY 2010) (APRIL MAY 2011) Ethical Pluralism means there are many views of looking at ethical problems and it is difficult to peg down to one solution, which is acceptable to all. Ethical Relativism is an action that is moral if it is within the framework of law or custom.</p>
<p>28. What is the main goal of Engineering Ethics? They should have a clear concept on related theories and standards involved To identify and enlist the types of ethical issues that is likely to occur</p>
<p>29. Distinguish self respect and self esteem? (Nov 2012) Self respect is a moral concept whereas Self esteem is a psychological concept. Self respect refers to the virtue of properly valuing oneself whereas self esteem refers to having a positive attitude towards oneself, the attitude may be excessive or unwarranted.</p>
<p>30. List out the categories of Civic Virtues.</p> <ul style="list-style-type: none"> • Civic Knowledge • Self-Restraint • Self-Assertion • Self-Reliance
<p>31. What is integrity? Integrity is defined as the unity of thought, word and deed (honesty) and open mindedness. It includes the</p>

capacity to communicate the factual information so that others can make well-informed decisions.
<p>32. Define work ethics Work ethics is defined as <i>a set of attitudes concerned with the value of work, which forms the motivational orientation</i>. The ‘work ethics’ is aimed at ensuring the economy, productivity, safety, health and hygiene, privacy, security and pension etc.,</p>
<p>33.What is service learning? Service learning refers to learning the service policies, procedures, norms, and conditions, other than ‘the technical trade practices’. The service learning includes the characteristics of the work, basic requirements, security of the job, and awareness of the procedures, while taking decisions and actions</p>
<p>34.Mention some civic virtues?</p> <ul style="list-style-type: none"> • To pay taxes to the local government and state, in time. • To keep the surroundings clean and green. • Not to pollute the water, land, and air • To follow the road safety rules. Etc.,
<p>35.Define Caring. Caring is feeling for others. It is a process which exhibits the interest in, and support for, the welfare of others with fairness, impartiality and justice in all activities, among the employees, in the context of professional ethics.</p>
<p>36.Define Sharing. Sharing is a process that describes the transfer of knowledge (teaching, learning, and information), experience (training), commodities (material possession) and facilities with others. The transfer should be genuine, legal, positive, voluntary, and without any expectation in return</p>
PART – B & C
<p>1.What is service learning? why service learning is important ? Explain characteristics of service Learning? <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:199</i></p>
<p>2.Define Empathy State and explain the elements benefits of Empathy and compare Empathy with Sympathy? <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:44</i></p>
<p>3.Explain the scope and importance of professional ethics in engineering? (MAY 17) <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:41</i></p>
<p>4.Discuss the role of yoga for professional excellence and stress management? (MAY 17) (NOV 16) (NOV 15) <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:2</i> https://www.yogajournal.com/meditation</p>
<p>5.Explain character and spirituality and their importance in ethics? (MAY 10) (MAY 16) <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:40-49,384</i></p>
<p>6.Explain the important of self confidence in ethics ? (MAY 16) <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:47</i></p>
<p>7.Explain in detail about engineering ethics and its philosophy? <i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:41</i></p>
<p>8.Where and how do moral problems arise in engineering? What is professional responsibility? Discuss theories about</p>

virtues. (MAY 11)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:55

9.Discuss the scope and aims of Engineering ethics. Scope and aim of engineering ethics Professions and professionalism?

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:3

UNIT II ENGINEERING ETHICS	
Senses of „Engineering Ethics“ – Variety of moral issues – Types of inquiry – Moral dilemmas – Moral Autonomy – Kohlberg’s theory – Gilligan’s theory – Consensus and Controversy – Models of professional roles - Theories about right action – Self-interest – Customs and Religion – Uses of Ethical Theories	
PART – A	
1. State the three types of Inquiry?(NOV/DEC2017) (Nov 2015)	
<ul style="list-style-type: none"> ○ Normal inquiries ○ Conceptual inquires ○ Factual inquires 	
2. What are the two important versions of utilitarianism?(NOV/DEC2017)	
<ul style="list-style-type: none"> ● Act utilitarianism ● Rule utilitarianism 	
3.what is meant by engineering as experimentation ?(APRIL MAY 2017)	
During the course of an engineer’s carrier he is frequently involved in research experimentation or the testing of new products especially during the design phase one needs to apply various experimental procedures which is called experimentation	
4.state the important of ethical theories ?(APRIL MAY 2017)	
Ethical theories are helpful in understanding and resolving moral dilemmas <ul style="list-style-type: none"> ● Ethical theories are useful in justifying professional obligations and ideals 	
5.State Gilligan’s theory ? (May 2016)	
Gilligan refers her context oriented emphasis on maintaining personal relationship as the ethics of care and contrasts it with Kohlberg’s ethics of rules and rights .	
6.what is meant by consensus ? (May 2016)	
Consensus means agreement when an individual exercise moral autonomy he may not be able to attain same results as other people obtain in practicing their moral autonomy	
7. What does Moral Autonomy mean? (MAY 2013)	
Moral Autonomy means the skill and habit of thinking rationally on ethical issues based on moral concern.	
8. List the complexities that are involved in moral situations. (NOV 2012)	
<ul style="list-style-type: none"> ● Some of the complexities that are involved in moral situations are ● Vagueness ● Conflicting Reasons ● Problems of Disagreement 	
9. Define professionalism. (APR/MAY 2015)	
Professionalism is often defined as the strict adherence to courtesy, honesty and responsibility when dealing with individuals or other companies in the business environment. This trait often includes a high level of excellence going above and beyond basic requirements. Work ethic is usually concerned with the personal values demonstrated by business owners or entrepreneurs and instilled in the company’s employees. The good work ethic may include completing tasks in a timely manner with the highest quality possible and taking pride in completed tasks.	
10. State the use of ethical theories. (MAY/JUNE 2014)	
<ul style="list-style-type: none"> ○ In understanding moral dilemmas ○ Justifying professional obligations and ideals ○ Relating ordinary and professional morality 	
11. What are the modes of professional roles? (NOV/DEC 14)	
Some of the Models of Professional Roles are Savior, Guardians, Bureaucratic Servant, and Social Servants, Social enabler and catalyst and Game Players.	
12. What do you mean by ‘Profession’?(MAY/JUN 12)	
Profession defines as a Declaration of belief in a course for a job.	
13. Define the term Empathy. (MAY/JUN 12) (APRIL MAY 2010)	
The term “empathy” is used to describe a wide range of experiences. Emotion researchers generally define empathy as the ability to sense other people’s emotions, coupled with the ability to imagine what someone else might be thinking or feeling	
14. Define Ethics?(NOV/DEC 13)	
<ul style="list-style-type: none"> * Study of right or wrong. * Good and evil. 	

<ul style="list-style-type: none"> * Obligations & rights. * Justice.
<p>15. Define Engineering Ethics?(MAY/JUNE 2014,APR/MAY 11) (APRIL MAY 2011)</p> <ul style="list-style-type: none"> * Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession. * Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.
<p>16. What is the need to study Ethics?</p> <ul style="list-style-type: none"> * To responsibly confront moral issues raised by technological activity. * To recognize and resolve moral dilemma. * To achieve moral autonomy.
<p>17. What are the different levels of moral development suggested by Kohlberg?</p> <ul style="list-style-type: none"> • The different levels of moral development suggested by Kohlberg are • Pre-conventional • Conventional • Post-conventional
<p>18. Differentiate Moral and Ethics?</p> <p>MORAL:</p> <ul style="list-style-type: none"> • Refers only to personal behavior. • Refers to any aspect of human action. • Social conventions about right or wrong conduct. <p>ETHICS:</p> <ul style="list-style-type: none"> • Involves defining, analyzing, evaluating and resolving moral problems and developing moral criteria to guide human behavior. • Critical reflection on what one does and why one does it. • Refers only to professional behavior.
<p>19. What is the method used to solve an Ethical problem?</p> <ul style="list-style-type: none"> • Recognizing a problem or its need. • Gathering information and defining the problem to be solved or goal to be achieved. • Generating alternative solutions or methods to achieve the goal. • Evaluate benefits and costs of alternate solutions. • Decision making & optimization. • Implementing the best solution.
<p>20. Differentiate Micro-ethics and Macro-ethics?</p> <p>Micro-ethics : Deals about some typical and everyday problems which play an important role in the field of engineering and in the profession of an engineer.</p> <p>Macro-ethics : Deals with all the societal problems which are unknown and suddenly burst out on a regional or national level.</p>
<p>21. What are the three types of Inquiry? (MAY 2013)</p> <ul style="list-style-type: none"> ▪ Normative Inquiry – Based on values. ▪ Conceptual Inquiry – Based on meaning. ▪ Factual Inquiry – Based in facts.
<p>22. What are the sorts of complexity and murkiness that may be involved in moralsituations?</p> <ul style="list-style-type: none"> • Vagueness • Conflicting reasons • Disagreement
<p>23. What are the steps in confronting Moral Dilemmas?(NOV/DEC 12)</p> <ul style="list-style-type: none"> • Identify the relevant moral factors and reasons. • Gather all available facts that are pertinent to the moral factors involved. • Rank the moral considerations in order of importance as they apply to the situation. • Consider alternative courses of actions as ways of resolving dilemma, tracing the full implications of each. • Get suggestions and alternative perspectives on the dilemma.
<p>24. Define Moral Autonomy? (NOV/DEC 14,MAY/JUN 12)</p> <ul style="list-style-type: none"> • Self-determining • Independent • Personal Involvement • Exercised based on the moral concern for other people and recognition of good moral reasons

25. State Rawl's principles?(APR/MAY 11)

- Each person is entitled to the most extensive amount of liberty compatible with an equal amount for others.
- Differences in social power and economic benefits are justified only when they are likely to benefit everyone, including members of the most disadvantaged groups.

26. Give the various tests required to evaluate the Ethical Theories?

- Theory must be clear, and formulated with concepts that are coherent and applicable.
- It must be internally consistent in that none of its tenets contradicts any other.
- Neither the theory nor its defense can rely upon false information.
- It must be sufficiently comprehensive to provide guidance in specific situations of interests to us.
- It must be compatible with our most carefully considered moral convictions about concrete situations.

27. What are the criteria required for a Profession?

- Knowledge
- Organization
- Public Good

28. Give the general criteria to become a Professional engineer?

Attaining standards of achievement in education, job performance or creativity in engineering that distinguish engineers from engineering technicians and technologists.

- Accepting as part of their professional obligations as least the most basic moral responsibilities to the public as well as to their employers, clients, colleagues and subordinates.

29. Define Integrity & Compromise?

- Integrity is the bridge between responsibility in private and professional life.
- In a negative sense it means to undermined integrity by violating one's fundamental moral principles.
- In a positive sense, however, it means to settle differences by mutual concessions or to reconcile conflicts through adjustments in attitude and conduct.

30. Give the two aspects of Honesty & two forms of Self-respect? (NOV 2016)

Truthfulness – meeting responsibilities concerning truth-telling.

Trustworthiness – Meeting responsibilities concerning trust.

two forms of Self-respect

- Recognition self-respect
- Appraisal self-respect

31. Explain Post-Conventional Level of Kohlberg Theory.

In the third level, the individuals are guided by strong principles and convictions but not by selfish needs or pressures from the society. Kohlberg calls the person in this level as Autonomous.

32. What are the types of Theories about Morality?

- Virtue ethics – Virtues and vices
- Utilitarianism – Most good for the most people
- Duty ethics – Duties to respect people

33. Explain Pre-Conventional Level of Kohlberg Theory.

It is the first level, which is based upon desire to derive benefits for one. The strong driving force at this stage is the desire to avoid punishment. People at this level try to act ethically only for self benefit and to avoid caught and punished. This is the development of children and few adults never cross this stage.

34. Explain Conventional Level of Kohlberg Theory.

In this level, the moral behavior of the individual is determined by the standards of the family, community, and society. Individuals at this level are motivated by the desire to be approved by others and to meet the expectations of the social unit. Kohlberg says that many individuals do not cross this level

35. Explain Post-Conventional Level of Kohlberg Theory.

In the third level, the individuals are guided by strong principles and convictions but not by selfish needs or pressures from the society. Kohlberg calls the person in this level as Autonomous.

36. What are the limitations or difficulties of Kohlberg Theory?

Theoretically, the classification was clear but when it is practically applied, it has some drawbacks namely, How to judge the individual belongs to the first, second or the third level. What are the criteria to judge and measure the individual for each level? The theory implies that the individual moral level is pre-programmed and inborn. If at all, any level can be changed it is not clear what the factors are.

37. Explain Pre-Conventional Level of Gilligan Theory.

It is the first level, which is based upon desire to derive benefits for one. The strong driving force at this stage is the desire to avoid punishment. People at this level try to act ethically only for self benefit and to avoid caught and punished. This is the development of children and few adults never cross this stage. (Same as Kohlberg Theory for this level alone)

38. Explain Conventional Level of Gilligan Theory.

Here the basic motive is willingness to sacrifice one's own interests and a strong desire not to hurt others interests. Mostly women come in this category.

39. Explain Post-Conventional Level of Gilligan Theory.

Here the individual strikes a mature balance between the two extremes – self interest on the one hand and sacrifice on the other hand. Here they apply context oriented reasoning like examining all facts, people and circumstances involved, rather than by applying general rules.

PART-B &C

1. What is meant by Moral Autonomy? Discuss the factors influencing person concern and the skills required to improve more Autonomy ? (NOV 13)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:16

2. Describe the professional roles played by an engineer? (NOV 15)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:32

3. Describe Kohlberg and Gilligan's theories on moral autonomy? (MAY 11) (MAY 12) (MAY 15) (MAY 17) (NOV 15)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:18,19

4. Name and describe the theories of right action? (MAY 10) (MAY 17) (NOV 16)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:51

5. Explain the details about the senses of engineering Ethics ? (MAY 16)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:15

6. Discuss in detail the various ethical theories and their uses ? (MAY 10) (MAY 16) (NOV 13)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:70

7. Explain the levels of moral development proposed by Kohlberg and Gilligan. Also bring out the drawbacks of Kohlberg theory? (MAY 10) (MAY 14) (NOV 14) (NOV 13)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:18,19

8. Discuss the theories pertaining to moral autonomy with specific reference to consensus and controversy? (MAY 14)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:22

9. Explain the types of inquiries in engineering? (MAY 12) (MAY 15) (NOV 14) (NOV 13) (NOV 11)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:9

UNIT III ENGINEERING AS SOCIAL EXPERIMENTATION
Engineering as Experimentation – Engineers as responsible Experimenters – Codes of Ethics – A Balanced Outlook on Law.
PART – A
<p>1. What is meant by conscientiousness?(NOV/DEC2017) Conscientiousness means commitment to live according to certain values it implies consciousness Engineers have to be sensitive to range of moral values and responsibilities, which are relevant in a given situation.</p>
<p>.2. What are codes of Ethics referred to?(NOV/DEC2017) The primary aspect of codes of ethics is to provide the basic framework for ethics judgment for a professional The code of ethics are referred as code of conduct express the commitment to ethical conduct shared by members of profession. In other words these code furnish common agreed upon standards for professional conduct</p>
<p>3.what are the uncertainties occur in model design ?(APRIL MAY 2017) While designing a product the designer engineer must deal with many uncertainties many of the risks can be expressed as probabilities and as educated guesses The uncertainties are in the form of application of the product materials used for producing the product changing economic conditions unfavorable environment conditions ,temperature etc</p>
<p>4.how does the law facilitate ethics in engineering ?APRIL MAY 2017) Engineers are expected to play a vital role in framing implementation and propagating the rules of engineering also they have to strictly adhere to those rules</p>
<p>5.Differentiate scientific experiments and engineering projects ?(May 2016) The engineering experiments involve human beings as experimental subjects in fact clients and customers have more control as they own the authority of that project.</p>
<p>6. Give the limitations of codes ?(May 2016) (Nov 2014) (Nov 2015) The four limitations of codes of ethics are as follows : The codes of ethics are broad guidelines restricted to general and vague wordings/phrases. Engineering codes often have internal conflicts which may result in moral dilemmas</p>
<p>7.Define Engineering Ethics (MAY 2013)(NOV 2013) Engineering ethics is the study of moral issues and decisions confronting individuals and organizations involved in engineering and the study of related questions about moral conduct, character, ideals and relationships of peoples and organizations involved in technological development</p>
<p>8. What do you understand by “a balanced outlook on law”?(MAY 2013) In order to live, work, and play together in harmony as a society, we need to carefully balance individual needs and desires against collective needs and desires. This is done to obtain ethical conduct. Ethical conduct defines a strong element of altruism, provides such a balance</p>
<p>9 . What is meant by valid consent? (NOV 2011) A consent, which has been given voluntarily, is known as valid consent. Valid consent is also defined as consent based on the information a rational person would want together with any other requested information to make a rational decision.</p>
<p>10. What are the Senses of Engineering Ethics?(NOV/DEC 14) (NOV 2013)</p> <ul style="list-style-type: none"> • An activity and area of inquiry. • Ethical problems, issues and controversies. • Particular set of beliefs, attitudes and habits. • Morally correct.
<p>11.What are the features of Engineering experimentation. (NOV/DEC 14) (MAY/JUN 12)</p> <ul style="list-style-type: none"> • Partial ignorance • Final outcome of projects • Knowledge about product
<p>12.what are the salient features of informed consent in engineering experimentation?(APR/MAY 11) (Nov 2011) (MAY 2015) (Nov 2015) Informed Consent is understood as including two main elements:</p> <ul style="list-style-type: none"> • Knowledge [Subjects should be given not only the information they request, but all the information needed to make a reasonable decision].

<ul style="list-style-type: none"> • Voluntariness [Subjects must enter into the experiment without being subjected to force, fraud, or deception].
<p>13. Give ant two examples in field of engineering for learning from the past.(NOV/DEC12) (April 2014)</p> <ul style="list-style-type: none"> • 1.Titanic disaster • 2. Nuclear reactor accident at Three Mile Island
<p>14.What are the uncertainties occur in the model designs?</p> <ul style="list-style-type: none"> • Model used for the design calculations. • Exact characteristics of the materials purchased. • Constancies of materials used for processing and fabrication. • Nature of the pressure, the finished product will encounter
<p>15. Define Engineering Ethics?(MAY/JUNE 2014,APR/MAY 11)</p> <ul style="list-style-type: none"> * Study of the moral issues and decisions confronting individuals and organizations engaged in engineering / profession. * Study of related questions about the moral ideals, character, policies and relationships of people and corporations involved in technological activity.
<p>16. List the reason behind viewing engineering projects as experiments.(MAY/JUN 12)</p> <ul style="list-style-type: none"> ▪ Any project is carried out in partial ignorance. ▪ The final outcomes of engineering projects, like those of experiments, are generally uncertain. ▪ Effective engineering relies upon knowledge gained about products before and after they leave the factory – knowledge needed for improving current products and creating better ones.
<p>17. What reasons lead to many repetitions of past mistakes?(MAY/JUN 12)</p> <p>This might be expected that engineers would learn not only from their own earlier design and operating results, but also from those of other engineers. Unfortunately, that is frequently not the case. Lack of established channels of communication, misplaced pride is not asking for information, embracement at failure or fear of litigation and plain neglect often impede flow of such information and lead to many repetitions of past mistakes.</p>
<p>18. What is the method used to solve an Ethical problem?</p> <ul style="list-style-type: none"> • Recognizing a problem or its need. • Gathering information and defining the problem to be solved or goal to be achieved. • Generating alternative solutions or methods to achieve the goal. • Evaluate benefits and costs of alternate solutions. • Decision making & optimization. • Implementing the best solution.
<p>19. What are the general features of morally responsible engineers?</p> <ul style="list-style-type: none"> • Conscientiousness. • Comprehensive perspective. • Autonomy. • Accountability.
<p>20. What is the purpose of various types of standards?</p> <ul style="list-style-type: none"> • Accuracy in measurement, interchangeability, ease of handling. • Prevention of injury, death and loss of income or property. • Fair value of price. • Competence in carrying out tasks. • Sound design, ease of communications. • Freedom from interference
<p>21. Define Code?</p> <p>Code is a set of standards and laws.</p>
<p>22. What are the roles of codes of ethics?(MAY/JUN 12/NOV /DEC2017) (NOV 2016)</p> <ul style="list-style-type: none"> • Inspiration and Guidance • Support • Deterrence and Discipline • Education and Mutual Understanding • Contributing to the Profession’s Public Image • Protecting the Status Quo • Promoting Business Interests
<p>23. What are the problems with the law in engineering?</p> <ul style="list-style-type: none"> • Minimal compliance • Many laws are without enforceable sanctions
<p>24. Differentiate scientific experiments and engineering projects?</p> <p>Scientific experiments are conducted to gain new knowledge, while “engineering projects are experiments that</p>

are not necessarily designed to produce very much knowledge”.

25. What are the uncertainties occur in the model designs?

- Model used for the design calculations.
- Exact characteristics of the materials purchased.
- Constancies of materials used for processing and fabrication.
- Nature of the pressure, the finished product will encounter.

26. What are the types of Theories about Morality?

- Virtue ethics – Virtues and vices
- Utilitarianism – Most good for the most people
- Duty ethics – Duties to respect people

27. Differentiate Weak Preferential Treatment and Strong Preferential Treatment?

- Weak preferential treatment involves giving an advantage to members of traditionally discriminated-against groups over equally qualified applicants who are members of other groups.
- Strong preferential treatment involves giving preference to minority applicants or women over better qualified applicants from other groups

28. What are the types of Theories about Morality?

- Virtue ethics – Virtues and vices
- Utilitarianism – Most good for the most people
- Duty ethics – Duties to respect people

29. What are the problems with the law in engineering?

- Minimal compliance
- Many laws are without enforceable sanctions.

30. What are the two general ways to apply ethical theories to justify the basic right of professional conscience?

- Proceed piecemeal by reiterating the justifications given for the specific professional duties.

Justify the right of professional conscience, which involves grounding it more directly in the ethical theories

31. Define ethical accountability.(APR/MAY 2011)

The people those who feel their responsibility always accepts the entire blame for their actions. In short, it is known as accountability, which means being culpable (guilty) and hold responsible for faults and respond to the assessment of others. Accountable persons will conduct themselves based on the specific circumstances.

32. List the limitations of ethical codes.(APR/MAY 2011,NOV/DEC 14,MAY/JUN 09) (Nov 2011)

- Codes are restricted to general and vague wording.
- Codes can't give a solution or method for solving the internal conflicts.
- Codes cannot serve as the final moral authority for professional conduct.
- Codes can be reproduced in a very rapid manner.

PART – B & C

1. What are codes of Ethics ? State and explain the function of codes of ethics and the objective to codes ? (NOV 11)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:105

2. Discuss the problems associated with laws in engineering and Enumerate the proper role of law engineering ? (NOV 15)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:113

3. What is the importance of codes of ethics ? explain in detail ? (MAY 17) (NOV 15)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:105

4. How can an engineer become a responsible experimenter? Explain in detail ? (MAY 17)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:89

5. How can engineer become a responsible experimenter ? highlight the code of ethics for engineers ? (MAY 16)

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:105

6. Discuss on the roles played by the codes of ethics set by professional societies? **(MAY 15) (MAY 16) (NOV 14)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:105

7. Explain “Engineers as Responsible Experimenters”.? **(MAY 12) (NOV 16)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:89

8. What are the moral and ethical lessons we can be learned from space shuttle challenger tragedy and how the principal actors behave as responsible experiments? **(MAY 10) (MAY 12) (MAY 14) (NOV 15) (NOV 14) (NOV 13)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:81

9. What are the similarities between engineering experiments and standard experiments? **(MAY 10) (MAY 11) (NOV 14)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:81,89

10. What are the aspects of engineering that make it appropriate to view engineering projects as experiments.

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:81

UNIT IV SAFETY, RESPONSIBILITIES AND RIGHTS
Safety and Risk – Assessment of Safety and Risk – Risk Benefit Analysis and Reducing Risk - Respect for Authority – Collective Bargaining – Confidentiality – Conflicts of Interest – Occupational Crime – Professional Rights – Employee Rights – Intellectual Property Rights (IPR) – Discrimination
PART – A
1. What are codes of Ethics referred to?(NOV/DEC2017) The primary aspect of codes of ethics is to provide the basic framework for ethics judgment for a professional the code of ethics are referred as code of conduct express the commitment to ethical conduct shared by members of profession. In other words these code furnish common agreed upon standards for professional conduct
2 Define Safety?(NOV/DEC2017) (Nov 2011) Safety means the state of being safe means protected from danger and harm The is always difficult to describe completely what may be safe for one person may not be safe for another person \
3. What is the use of risk analysis?(APRIL MAY 2017) (May 2012) (NOV 2013) (MAY 2015) In practice all the dangerous sports such as motorcycle racing skilling hang gliding bungee jumping horseback riding boxing etc are carried out under the assumed control of the participants these are use of risk analysis
4. Define the term collective bargaining? APRIL MAY 2017) (May 2012) <ul style="list-style-type: none"> • International labor organization (ILO) has defined collective bargaining as negotiation about working conditions and terms of employment between an employer and one or more representative with a view to reaching agreement
5. Differentiate between Risk analysis and Risk benefit analysis (May 2016) (Nov 2015) Risk analysis is the process that allows management to demonstrate that it has met its obligation of due diligence when making a decision about forward with a new project Risk benefit analysis is a technique similar to cost benefit analysis used to analyze risk in the project
6. what is intellectual property right?(NOV/DEC2016) (NOV 2013) Intellectual property (IP) is a property that results from mental labor The intellectual property is originating mainly from the activities of the human intellect
7. Define Engineering Ethics (MAY 2013)(NOV 2013) Engineering ethics is the study of moral issues and decisions confronting individuals and organizations involved in engineering and the study of related questions about moral conduct, character, ideals and relationships of peoples and organizations involved in technological development
8. What shall be the approach of government Regulator towards risk mitigation? (MAY 2013) <ul style="list-style-type: none"> ○ A number of techniques are available for reducing risk. Some of them are Application of inherent safety concepts in design. For example in the case of liquefied gas, storage system the present trend is to replace pressurized storages with cryogenic storage at atmospheric pressure. Use of diversity and redundancy principles in instrumented protection schemes. Regular inspection and testing of safety systems to ensure reliability. Training of operating personal and regular audits to ensure workability of the systems and procedures.
9. What is meant by risk? State the causes of risks (NOV 2011) (Nov 2014) (NOV 2016) A risk is the potential that some thing unwanted and harmful may occur. These days the new risks are the less obvious effects of technology are now making way to public consciousness. The mathematical form is $R = P * C$ Causes of risks are job overconfidence, technological complacency, lack of safe exists
10. What is safety? What does relative safety express? (NOV 2011) A thing is safe if its risks are justified to be acceptable. Thus, a thing is safe if the perceived risk of the person, who judges is less and it is unsafe if the perceived risk are high. Relative safety indicates the safety the product with respect to similar things.
11. Give the criteria which helps to ensure a safety design? The minimum requirement is that a design must comply with the applicable laws. An acceptable design must meet the standard of “accepted engineering practice.”
12. Alternative designs that are potentially safer must be explored. Engineer must attempt to foresee potential misuses of the product by the consumer and must design to avoid these problems. Once the product is designed, both the prototypes and finished devices must be rigorously tested.
13. What are the factors for safety and risk? <ul style="list-style-type: none"> • Voluntary and Involuntary risk

<ul style="list-style-type: none"> • Short-term and Long-term risk • Expected probability • Reversible effects • Threshold levels to risk
<p>14. What are the drawbacks in the definition of Lawrence?</p> <ul style="list-style-type: none"> • Underestimation of risks • Overestimation of risks • No estimation of risks
<p>15. Give the categories of Risk?</p> <ul style="list-style-type: none"> • Low consequence, Low probability (which can be ignored) • Low consequence, High probability • High consequence, Low probability • High consequence, High probability
<p>16. What are the factors that affect Risk Acceptability?</p> <ul style="list-style-type: none"> • Voluntarism and control • Effect of information on risk assessment • Job related pressures • Magnitude and proximity of the people facing risk
<p>17. What is the knowledge required to assess the risk?</p> <ul style="list-style-type: none"> • Data in design • Uncertainties in design • Testing for safety • Analytical testing • Risk-benefit analysis
<p>18. What are the analytical methods?</p> <ul style="list-style-type: none"> • Scenario analysis • Failure modes & effect analysis • Fault tree analysis • Event tree analysis etc
<p>19. What are the three conditions referred as safe exit? (APRIL MAY 2011)</p> <ul style="list-style-type: none"> • Assure when a product fails it will fail safely. • Assure that the product can be abandoned safely. • Assure that the user can safely escape the product.
<p>20. How will an engineer assess the safety?</p> <ul style="list-style-type: none"> • The risks connected to a project or product must be identified. • The purposes of the project or product must be identified and ranked in importance. • Costs of reducing risks must be estimated. • The costs must be weighed against both organizational goals and degrees of acceptability of risks to clients and the public. • The project or product must be tested and then either carried out or manufactured.
<p>20. What is the purpose of various types of standards?</p> <ul style="list-style-type: none"> • Accuracy in measurement, interchangeability, ease of handling. • Prevention of injury, death and loss of income or property. • Fair value of price. • Competence in carrying out tasks. • Sound design, ease of communications. • Freedom from interference
<p>21. What are the reasons for Risk-Benefit Analysis?</p> <p>Risk-benefit analysis is concerned with the advisability of undertaking a project. It helps in deciding which design has greater advantages.</p> <p>It assists the engineers to identify a particular design scores higher with that of the another one.</p>
<p>22. Are the engineers responsible to educate the public for safe operation of the equipment? How?</p> <p>Yes, as per the engineers are concerned with they should have their duty as to protect for the safety and well being of the general public. Analyzing the risk and safety aspects of their designs can do this.</p>
<p>23. Define Safety?</p> <p>In the definition stated by William W. Lawrence safety is defined, as a thing is safe if its risks are acceptable. A</p>

thing is safe with respect to a given person or group, at a given time, if its risk is fully known, if those risks would be judged acceptable, in light of settled value principles. In the view of objective, safety is a matter of how people would find risks acceptable or unacceptable.

24. What is the definition of risks? (NOV/DEC 13)

A risk is the potential that something unwanted and harmful may occur. Risk is the possibility of suffering harm or loss. It is also defined as the probability of a specified level of hazardous consequences, being realized. Hence Risk (R) is the product of Probability (P) and consequence(C) (i.e)

$$R = P * C$$

25. Define Acceptability of risks? (NOV/DE 14)

A risk is acceptable when those affected are generally no longer apprehensive about it. Doubtfulness depends mainly on how the people take the risk or how people perceive it.

26. What are the safety measures an engineer must know before assessing a risk of any product?

The factors are:

- Does the engineer have the right data?
- Is he satisfied with the present design?
- How does he test the safety of a product?
- How does he measure and weigh the risks with benefits for a product

27. What is the use of knowledge of risk acceptance to engineers?

Though past experience and historical data give better information about safety of products designing there are still inadequate. The reasons are

- The information is not freely shared among industries
- There also new applications of old technologies that provides available data, which are less useful.
- So, in order to access the risk of a product, the engineers must share their knowledge and information with others in a free manner

28 What is meant by Disaster? Give an example. (NOV 2013)

A disaster does not take place until a seriously disruptive event coincides with a state of insufficient preparation. Example: The Titanic collision with an iceberg constituted an emergency, which turned into a disaster because there were too few lifeboats

29.What are the positive uncertainties in determining risks?

- There are three positive uncertainties. They are:
- Purpose of designing
- Application of the product
- Materials and the skill used for producing the product.

30 What is the use of Risk-Analysis? What are the three factors involved here?

Risk Analysis is used for the assessment of the hazardous associated with an industrial or commercial activity. It involves identifying the causes of unwanted hazardous events and estimating the consequences and likelihood of these events. Three factors involved in this are:

- Hazard Identification
- Consequences analysis
- Probability estimation.

31. Explain the two types of Risk?

- Personal Risk:
- An individual, who is given sufficient information, will be in a position to decide whether to take part in a risky activity or not. They are more ready to take on voluntary risks than involuntary risks.
- Public Risks:
- Risks and benefits to the public are more easily determined than to individuals, as larger number of people is taken into account. Involuntary risks are found here.

32. What does Strict Liability mean?

Strict liability means if the sold product is defective; the manufacturer concerned is liable for any harm that results to users. Negligible is not at all an issue based.

33. What is the main barrier to educational attempts?

An important barrier to educational attempt is that people belief change slow and are extraordinarily resistant to new information.

34. What happens to the products that are not safe?

Products that are not safe incur secondary costs to the manufacturer beyond the primary costs that must also be taken into account costs associated with warranty expenses, loss of customer will and even loss of customers and so.

35. What does Open-mindedness refer to?

Open-mindedness refers once again not allowing a preoccupation with rules to prevent close examination of safety problems that may not be covered by rules.

<p>36. What was the problem in the Chernobyl reactor?</p> <ul style="list-style-type: none"> • The problem was that, • The output was maintained to satisfy an unexpected demand. • The control device was not properly reprogrammed to maintain power at the required level. • Instead of leaving fifteen control rods as required, the operators raised almost all control rods because at the low power level, the fuel had become poisoned.
<p>37.. What is the need for Protection to IPR? (APR/MAY 11)</p> <ul style="list-style-type: none"> • Prevent plagiarism. • Prevent others using it. • Prevent using it for financial gain. • Fulfill as an obligation to funding agency.
<p>38. List the problems related to price fixing?(APR/MAY 11)</p> <p>The person who were participated in the price fixing game were highly reputed officials of their companies and in their communities. one of the persons was the president of the local chamber of commerce. they did not consider their activities as crime or harmful. Many of them argued that their conduct was beneficial. They also argued that fixation of price was benefit to the public by stabilizing the prices. This crime of price fixing had been spread over the industries for a long period of time.</p>
<p>39. What are the main features of Whistle Blowing? (NOV/DEC 13,(APR/MAY 15) (Nov 2015)</p> <ul style="list-style-type: none"> • Act of disclosure • Topic • Agent • Recipient
<p>40. What does the term collective bargaining refer to?(APR/MAY 15,MAY/NOV/DEC2017) (NOV 2016)</p> <p>Collective bargaining is the negotiation process that takes place between an employer and a group of employees when certain issues arise. The employees rely on a union member to represent them during the bargaining process, and the negotiations often relate to regulating such issues as working conditions, employee safety, training, wages, and layoffs. When an agreement is reached, the resulting “collective bargaining agreement,” or “CBA,” becomes the <u>contract</u> governing employment issues.</p>
<p>41 What is meant by occupational crime(MAY/JUN 14)</p> <p>Occupational crimes are illegal acts made possible through one’s lawful employment. It is the secret violation of laws regulating work activities. When committed by office workers of professionals, occupational crime is called ‘white-collar crime’</p>
<p>42. What is the difference between bribe and gift.(NOV/DEC 14)</p> <p>A Bribe is a substantial amount of money or goods offered beyond a stated business contract with the aim of winning an advantage in gaining or keeping the contract. Gifts are not bribes as long as they are small gratuities offered in the normal conduct of business.</p>
<p>43. What does whistle blowing mean?(NOV/DEC 14)</p> <p>Whistle-blowing is alerting relevant persons to some moral or legal corruption, where “relevant persons” are those in a position to act in response, if only by registering protest. i.e. the employee disclosure of an employer’s illegal or illegitimate practices to persons or organizations that may be able to take corrective actions. The conditions to be met for whistle-blowing are</p> <ul style="list-style-type: none"> • Need • Proximity • Capability • Last resort
<p>44. Distinguish ‘ Institutional authority’ and ‘Expert authority’. (NOV/DEC 12)</p> <p>Institutional Authority is acquired, exercised and defined within organizations. It may be defined as the institutional right given to a person to exercise power based on the resources of the institution.</p> <p>Expert authority is the possession of special knowledge, skill or competence to perform task or give sound advice.</p>
<p>45. What do you understand by the term ‘Kick backs’? (NOV/DEC 12)</p> <p>Prearranged payments made by contractors to companies or their representatives in exchange for contracts actually granted are called kickbacks</p>
<p>46. Differentiate Human Rights and Professional Rights? (MAY/JUN 12)</p> <p>Human Rights – Possessed by virtue of being people or moral agents.</p> <p>Professional Rights – Possessed by virtue of being professional having special moral responsibilities.</p>
<p>47. Define Discrimination? (MAY/JUN 12)</p> <p>Discrimination means morally unjustified treatment of people on arbitrary or irrelevant grounds.</p>
<p>48. Define Collegiality?(NOV/DEC 13) (APRIL MAY 2010) (MAY 2015)</p> <p>Collegiality is a kind of connectedness grounded in respect for professional expertise and in a commitment to the</p>

goals and values of the profession and collegiality includes a disposition to support and cooperate with one's colleagues.
<p>49. What are the central elements of collegiality? (NOV/DEC 13)</p> <ul style="list-style-type: none"> • Respect • Commitment • Connectedness • Cooperation
<p>50. What are the two senses of Loyalty? (APRIL MAY 2011) (2013) (April 2014)</p> <p>Agency Loyalty – Acting to fulfill one's contractual duties to an employer. It's a matter of actions, whatever its motives.</p> <p>Identification Loyalty – Has as much to do with attitudes, emotions, and a sense of personal identity as it does with actions.</p>
<p>51. When may an Identification Loyalty be said as obligatory?</p> <p>Employees must see some of their own important goals as met by and through a group in which they participate. Employees must be treated fairly, each receiving his or her share of benefits and burdens</p>
<p>52. What is the relationship between the Loyalty to the company and Professional responsibility to the public?</p> <ul style="list-style-type: none"> • Acting on professional commitments to the public can be a more effective way to serve a company than a mere willingness to follow company orders. • Loyalty to companies or their current owners should not be equated with merely obeying one's immediate supervisor. An engineer might have professional obligations to both an employer and to the public that reinforce rather than contradict each other
<p>53. What is the basic moral task of salaried engineers?</p> <p>The basic moral task of salaried engineers is to be aware of their obligations to obey employers on one hand and to protect and serve the public and clients of the other.</p>
<p>54. What are the guidelines to reach an agreement?</p> <ul style="list-style-type: none"> • Attack problem and not people. Build trust. Start with a discussion and analysis of interests, concerns, needs. It begin with interests, not positions or solutions. Listen. Brainstorm; suggesting an idea does not mean one aggress with it. Develop multiple options. Use objective criteria whenever possible. Agree on how something will be measured
<p>55. Define confidential information?</p> <p>Confidential information is information deemed desirable to keep secret.</p>
<p>56. What are the criteria for identifying that information is "labeled" confidential at the workplace?</p> <ul style="list-style-type: none"> • Engineers shall treat information coming to them in the course of their as confidential. <p>Identify any information which if it became known would cause harm to the corporation or client</p>
<p>59. Define Conflicts of Interest?(MAY/JUN 12) (Nov 2011)</p> <p>Conflict of interests is a situation in which two or more interests are not simultaneously realizable. It is the disagreement between public obligation and self-interest of an official</p>
<p>60. Why does a conflict of interests arise?</p> <ul style="list-style-type: none"> • Financial Investments • Insider Trading • Bribe • Gifts • Kickbacks
<p>61. What are the types of Conflicts of interest?</p> <ul style="list-style-type: none"> • Actual conflict of interest • Potential conflict of interest • Apparent conflict of interest
<p>62. What are the forms of Conflicts of interest?</p> <ul style="list-style-type: none"> • Interest in other companies • Moonlighting • Insider information
<p>63. How will you solve the Conflict problems?</p> <ul style="list-style-type: none"> • Finding the creative middle way. • Employing Lower-level considerations. • Making the hard choice.
<p>64. What are the essential elements of IPR?</p> <ul style="list-style-type: none"> • Patents • Copyrights • Trademarks
<p>65. What are the requirements of Patents?</p>

- Problem of invention
- Current report of the problems to address
- Solution or procedure to the problem
- Extent of novelty or inventive
- Application or uses
- Details of the inventor

66. What are the types of Patents?

- Utility patents
- Design patents

PART-B & C

1.What is meant by conflict of interest? Distinguish between general and professional conflicts of interest and discuss the various types of conflicts of interest?

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:216

2.What are intellectual property rights? Explain the elements of intellectual property rights in details and benefits of IPRS? **(NOV 15) (NOV 14)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:242

3.Discuss in detail about the employee Rights and its role in the organizations? **(MAY 15) (MAY 17)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No: 264

4.What are the factors that affect risk acceptability? what is the use of knowledge of risk acceptance to engineer ? **(MAY 14)(MAY 16)(NOV 15)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:141

5.Discuss The significance of intellectual property rights also explain the legislation covering IPR India? **(MAY 16)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:242

6.Discuss the causes of Bhopal disasters. Explain the responsibility of engineers in the design of product in the design stage itself before the event of an accident? **(MAY 11)(MAY 14)(NOV 13) (NOV 11)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:

7.Explain how the risks are reduced & explain the concept of 'Risk-Benefit Analysis'? **(MAY 12)(MAY 14)(MAY 15) (MAY 17) (NOV 11) (NOV 13) (NOV 14)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:153

8.Write Short notes on Occupational crime , Whistle Blowing ,IPR, Discrimination? **(MAY 10)(MAY 11)(MAY 15)(NOV 15) (NOV 13)**

Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:242,274

UNIT V GLOBAL ISSUES

Multinational Corporations – Environmental Ethics – Computer Ethics – Weapons Development – Engineers as Managers – Consulting Engineers – Engineers as Expert Witnesses and Advisors – Moral Leadership – Code of Conduct – Corporate Social Responsibility

PART – A

1 . What is meant by technology transfer?(NOV /DEC2017) (APRIL MAY 2010)?

Technology transfer is the process of moving technology to a quite new set of conditions and implementing it there. The transfer of technology may be conducted by a variety of agents such as governments, volunteer service organizations, consulting companies and MNC.

2. Point out the responsibilities of consulting engineers?(NOV.DEC2017)

Consulting engineers generally exercise their consulting activities as independent; they are paid for their services by fees, not by salaries.

3.what do you mean by IPR ?(APRIL MAY 2017)(April 2014) (May 2016)

Intellectual property (IP) is a property that results from mental labor. The intellectual property is originating mainly from the activities of the human intellect.

4. How is corporate social responsibilities practiced ? (APRIL MAY 2017)

The MNC's and their employers have to obey the above human rights while exercise their business without fail.

5.what is moral leadership ?(NOV/DEC 2016) (APRIL MAY 2010) (NOV 2013) (MAY 2015) (Nov 2015)

When the leader's goals are not only permissible but also morally valuable then it's known as Moral leadership.

6.what is meant by Globalization ?(May 2016)

Our lives are increasingly dependent upon the goods/services provided over the world and are influenced by the business from around all the corners of the world. In general, the world has become a global village and has a good economy. This is the concept of globalization.

7.What is the basic ethical and moral responsibility of a manager-engineer?

Ethical responsibility:

The basic ethical responsibilities of managers are to produce a good product or valuable service, only after taking into consideration maintaining respect for human beings, which includes customers, employees and the general public.

Moral responsibility:

As managers, an engineer's moral responsibility is to produce safe and useful products that are also profitable.

8.What is meant by moral leadership ?(NOV/DEC 13)

- A leader, by definition, is one who guides, who shows the way by example. A leader, if he is to be effective, must have the ability to persuade others. If there is no persuasion, there simply is no leadership.
- In order to be able to persuade others to follow a course of action, a leader must have personal integrity. If a man cannot be trusted, he cannot lead, for the populous will not be guided by someone in whom they have no confidence.

9.Define the term ‘ Appropriate technology’.(NOV/DEC 12)

Appropriate technology means identification, transformation and implementation of the most suitable technology for a new set of conditions. These conditions include social factors which are apart from economic and technical engineering constraints. Identification can be done on the basis of human values and needs.

10.What is the Importance of IPR?

Give the inventors exclusive rights of dealing

- Permit avoiding of competitors and raise entry barriers.
- Permit entry to a technical market.

Generate steady income by issuing license

11.What is a Trade secret?

A trade secret is a secret formula, pattern, or device that is used in a business and provides a commercial advantage.

12.Differentiate External Whistle Blowing and Internal Whistle Blowing?

External Whistle Blowing – Information is passed outside the organization.

Internal Whistle Blowing – Information is conveyed to someone within the organization.

<p>13. Differentiate Open Whistle Blowing and Anonymous Whistle Blowing?</p> <p>Open Whistle Blowing – Individuals openly reveal their identity as they convey the information Anonymous Whistle Blowing – Involves concealing one’s identity</p>
<p>14. Define Employee Rights?</p> <p>Employee rights are rights, moral or legal, that involve the status of being an employee. They include some professional rights that apply to the employer-employee relationship</p>
<p>15. When are Whistle Blowing morally permitted and morally obligated</p> <ul style="list-style-type: none"> • Whistle blowing is morally permitted when • If the harm that will be done by the product to the public is serious and considerable. • If they make their concerns known to their superiors
<p>16. What are the three versions of Relativism?</p> <ul style="list-style-type: none"> ▪ Ethical Relativism ▪ Descriptive Relativism ▪ Moral Relativism
<p>17. What are the moral dimensions of an Engineer manager?</p> <ul style="list-style-type: none"> ○ Information rights and obligation ○ Property rights ○ Accountability and control ○ System quality
<p>18. Give any ten International rights suggested by Donaldson? (NOV/DEC 14)</p> <ul style="list-style-type: none"> • The right to freedom of physical movement. • The right to ownership of property. • The right to freedom from torture. • The right to a fair trial. • The right to nondiscriminatory treatment. • The right to physical security.
<p>19. Give some of the Environmental issues of concern to engineers?</p> <ul style="list-style-type: none"> ○ Releasing harmful substance into air and water. ○ Using toxic substance in food processing. ○ Disturbing land and water balances
<p>20. What are the issues in Computer ethics? (Nov 2011) (NOV 2016)</p> <p>Power Relationship</p> <ul style="list-style-type: none"> Job Elimination Customer Relations Biased Software Stock Trading Unrealistic Expectations Political Power Military Weapons
<p>21. What are the problems of Defense industry?</p> <ul style="list-style-type: none"> • Problem of waste and huge cost in implementing and maintaining a weapons system. • Problem of Technology creep. • Problems in maintaining secrecy. • Every country allocates large amount of its resources to defense sector [India spent ¼ of its resource for defense]
<p>22. What are ways to promote an Ethical climate?</p> <ul style="list-style-type: none"> • Ethical values in their full complexity are widely acknowledged and appreciated by managers and employees alike. • The sincere use of ethical language has to be recognized as a legitimate part of corporate dialogue. • The top level management must establish a moral tone in words, in policies, by personal example etc. • The management has to establish some procedures for resolving conflicts.
<p>23. What are the important forms of Conflicts?</p> <ul style="list-style-type: none"> • Conflicts based on schedules • Conflicts which arises in evolving the importance of projects and the department.

- Conflicts based on the availability of personal for a project.
- Conflicts over technical

24. What is meant by technology transfer? (APRIL MAY 2010) (Nov 2015)

- Separate people from the problem.
- Focus on interest and not on positions.
- Generate a variety of possibilities before deciding what to do.
- Insist that the result be based on some objective standard.

25. What are the normative models to be used to avoid conflicts?

- Hired Guns
- Value-neutral Analyst

26. What are the characteristics of an engineer as expert advisers in public planning and policy making?

- Honesty
- Competence
- Diligence
- Loyalty

27. How can Deceptive advertising be done?

- By outright lies.
- By half-truths.
- Through exaggeration.
- By making false innuendos, suggestions or implications.
- Through obfuscation created by ambiguity, vagueness or incoherence.
- Through subliminal manipulation of the unconscious.

28. Give the usage of the code of conduct? (NOV 2016)

The code of conduct will help the engineers to have a set of standards of behavior. They act as guidelines for their behavior. It helps to create workplaces where employees are encouraged to make ethical implications.

29. Point out the responsibilities of consulting engineers?(NOV /DEC 2017)

- Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
- Engineers shall perform services only in the areas of their competence.
- Engineers shall issue public statements only in an objective and truthful manner.
- Engineers shall act in professional matters for each employer or client as faithful agents or trustees, and shall avoid conflicts of interest.
- Engineers shall build their professional reputation on the merit of their services and shall not compete unfairly with others.
- Engineers shall act in such a manner as to uphold and enhance the honor, integrity and dignity of the profession.
- Engineers shall continue their professional development throughout their careers and shall provide opportunities for the professional development of those engineers under their supervision.

30. Enumerate the Code of Ethics by ASME? (May 2012)

Engineers uphold and advance the integrity, honor and dignity of the engineering profession by:

- I. using their knowledge and skill for the enhancement of human welfare;
 - II. being honest and impartial, and serving with fidelity their clients (including their employers) and the public; and
 - III. striving to increase the competence and prestige of the engineering profession.
1. Engineers shall hold paramount the safety, health and welfare of the public in the performance of their professional duties.
 2. Engineers shall perform services only in the areas of their competence; they shall build their professional reputation on the merit of their services and shall not compete Unfairly with others.

PART – B & C

- 1.State the types of concern for environment by the engineers discuss the Approaches to resolve environmental problems
What do professional codes of Ethics say about the environment?

<p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:377</i></p>
<p>2.What is computer Ethics? State and Explain the categories of ethical problems and the unethical acts computer as an instrument of unethical behavior What is meant by hacking? (MAY 07)(NOV 15) (NOV 14) (NOV 13) (NOV 11)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:319</i></p>
<p>3.Discuss in detail about the moral and ethical issues involved in use of computers? (MAY 17)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:375</i></p>
<p>4.Explain the role of engineers as consultant and expert witness? (MAY 14)(MAY 17)(NOV 15)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:367</i></p>
<p>5.Describe In details about the global issues of weapon development? (MAY 10)(MAY 16)(NOV 11)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:332</i></p>
<p>6.Justify engineers as expert witness and advisors with suitable examples? (MAY 10)(MAY 11)(MAY 16)(NOV 15) (NOV 14)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:367</i></p>
<p>7.What is environment ethics? Explain its significance. Give some of the environment issues of concern to engineers? (MAY 10)(MAY 11)(MAY 15)(NOV 14)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:302</i></p>
<p>8.Discuss the various global issues that have an impact on business. (MAY 15)</p> <p><i>Ref: Ethics in Engineering by Mike W. Martin and Roland Schinzinger, Pg.No:332</i></p>

**ME 6502 HEAT AND MASS TRANSFER
PART- A QUESTIONS WITH ANSWERS**

**UNIT 1
CONDUCTION**

1. Define Heat transfer?

Heat transfer can be defined as the transmission of energy from one region to another region to temperature difference.

2. What are the modes of heat transfer? [MAY / JUNE 2016]

i) Conduction ii) Convection iii) Radiation

3. What is conduction?

Heat conduction is a mechanism of heat transfer from a region of high temperature to a region of low temperature with in a medium (Solid, liquid or Gases) or different medium in direct physical contact. In conduction, energy exchange takes place by the kinematics motion or direct impact of molecules .Pure conduction is found only in solids.

4. State Fouries law of conduction. [NOV/DEC 2016]

The rate of heat conduction is proportional to the area measured normal to the direction of heat flow and to the temperature gradient in that direction.

5. Define Thermal conductivity

Thermal conductivity is defined as the ability of a substance to conduct heat.

6. List down the three types of boundary conditions.

- Prescribed temperature
- Prescribed heat flux
- Convection boundary conditions.

7. Define convection.

Convection is a process of heat transfer that will occur between solid surface and a fluid medium when they are at different temperatures. Convection is possible only in the presence of fluid medium.

8. Define Radiation

The heat transfer from one body to another without any transmitting medium is known as radiation .It is an electromagnetic wave phenomenon.

9. State Newtons law of cooling or convection law.

Heat transfer by convection is given by Newtons law of cooling

$$Q = hA (T_s - T)$$

Where;-

A- Area exposed to heat transfer in m^2

h - Heat transfer coefficient of the surface in K

T_s -Temperature of the surface in K

T - Temperature of the fluid in K

10. Define overall heat transfer co-efficient.

The overall heat transfer by combined modes is usually expressed in terms of an overall conductance or overall heat transfer co-efficient Heat transfer,

11. Define fins or extended surfaces.

It is possible to increase the heat transfer rate by increasing the surface area of heat transfer. The surfaces used for increasing heat transfer are called extended surfaces sometimes known as fins.

12. State the applications of fins. [NOV/DEC 2011]

- Cooling of electronic components.
- Cooling of motor cycle engines.
- Cooling of small capacity compressors
- Cooling of transformers.

13. Define fin efficiency. [NOV/DEC 2015]

The efficiency of a fin is defined as the ratio of actual heat transferred to the maximum possible heat transferred by the fin.

$$= \frac{Q_{fin}}{Q_{max}}$$

14. Define Fin effectiveness. [NOV/DEC 2015]

Fin effectiveness is the ratio of heat transfer with fin to that without fin
Fin effectiveness = $\frac{Q \text{ with fin}}{Q \text{ without fin}}$

15. What is meant by steady state heat conduction?

If the temperature of a body does not vary with time, it is said to be in a steady state and that type of conduction is known as steady state heat conduction.

16. What is meant by transient heat conduction or unsteady state conduction?

If the temperature of a body varies with time, it is said to be in a transient state and that type of conduction is known as transient heat conduction or unsteady state conduction.

17. What is Periodic heat flow?

In Periodic heat flow, the temperature varies on a regular basis

Example; 1. Cylinder of an IC engine.

18. What is non Periodic heat flow?

In non Periodic heat flow, the temperature at any point within the system varies non linearly with time.

Example: 1. Heating of an ingot in furnace.
2. Cooling of bars.

19. What is meant by Newtonian heating or cooling process?

The process in which the internal resistance is assumed as negligible in comparison with its surface resistance is known as Newtonian heating or cooling process.

20. What is meant by Lumped heat analysis? [MAY/JUNE 2016]

In a Newtonian heating or cooling process the temperature throughout the solid is considered to be uniform at a given time. Such an analysis is called Lumped heat capacity analysis.

21. What is meant by semi-infinite solids?

In semi-infinite solids, at any instant of time, there is always a point where the effect of heating or cooling at one of its boundaries is not felt at all. At this point the temperature remains unchanged. In semi infinite solids, the biot number values is

22. What is meant by infinite solid?

A solid which extends itself infinitely in all directions of space is known as infinite solid. In infinite solids, the biot number value is in between 0.1 and 100.

$$0.1 < Bi < 100$$

23. Define Biot number.

It is defined as the ratio of internal conductive resistance to the surface conductive resistance. Internal conductive resistance

$$Bi = \frac{\text{Internal conductive resistance}}{\text{surface conductive resistance}}$$

24. What is the significance of Biot number?

Biot number is used to find Lumped heat analysis, Semi infinite solids and infinite solids.

If $Bi < 0.1$ Lumped heat analysis.

$Bi = 0.1 < Bi < 10025$.

25. What are the factors affecting the thermal conductivity? [NOV/DEC 2017]

- Moisture
- Density of material
- Pressure

- Temperature
- Structural of material.

26. Explain the significance of thermal diffusivity.

The physical significance of thermal diffusivity is that it tells us how fast heat is propagated or it diffuses through a material during changes of temperature with time.

27. What are Heislers charts? [NOV/DEC 2017]

In Heislers chart, the solutions for temperature distributions and heat flows in plane walls, long cylinders and spheres with finite internal and surface resistance are presented. Heislers charts are nothing but a analytical solutions in the form of graphs.

28. State some practical application of transient heat analysis. [APRIL/MAY 2017]

1. Heat transfer in engines
2. Heat transfer in boilers
3. Heat transfer in rocket nozzles
4. Heat transfer in electric irons

29. Distinguish between conduction and convection heat transfer. [APRIL/MAY 2017]

Conduction	Convection
Heat conduction is a mechanism of heat transfer from a region of high temperature to a region of low temperature with in a medium (Solid, liquid or Gases)or different medium in direct physical contact. In conduction, energy exchange takes place by the kinematics motion or direct impact of molecules .Pure conduction is found only in solids.	Convection is a process of heat transfer that will occur between solid surface and a fluid medium when they are at different temperatures. Convection is possible only in the presence of fluid medium.

30. Will the thermal contact resistance be greater for smooth or rough plan surface?

Why? [NOV /DEC 2015]

Rough surface have higher thermal contact resistance air is trapped between rough surface and after more resistance.

31. Under what circumstance from the heat transfer point of view will the use of finned walls be better? [NOV/DEC 2016]

Fins are used in a large number of applications to increase the heat transfer from surfaces. Typically, the fin material has a high thermal conductivity. The fin is exposed to a flowing fluid, which cools or heats it, with the high thermal conductivity allowing increased heat being conducted from the wall through the fin.

UNIT II

CONVECTION

32. What is dimensional analysis?

Dimensional analysis is a mathematical method which makes use of the study of the dimensions for solving several engineering problems. This method can be applied to all types of fluid resistance, heat flow problems in fluid mechanics and thermodynamics.

33. State Buckingham's theorem.

Buckingham's theorem states as follows:

“If there are n variables in a dimensionally homogeneous equation and if these contain M fundamental dimensions, then the variables are arranged into $(n-m)$ dimensionless terms. These dimensional terms are called Buckingham's theorem.

34. What are all the advantages of dimensional analysis?

- It expresses the functional relationship between the variables in dimensional terms.
- It enables getting up a theoretical solution in a simplified dimensional form.
- The results of one series of test can be applied to a large number of other similar problems with the help of dimensional analysis.

35. What are all the limitations of dimensional analysis?

- The complete information is not provided by dimensional analysis .It only indicates that there is some relationship between the parameters.
- No information is given about the internal mechanism of physical phenomenon.
- Dimensional analysis does not give any clue regarding the selection of variables.

36. Define Reynolds number (Re). [APRIL/MAY 2017]

It is defined as the ratio of inertia force to viscous force.

$$R_e = \frac{\text{Inertia force}}{\text{Viscous force}}$$

37. Define Prandtl number (Pr)

It is the ratio of the momentum diffusivity to the thermal diffusivity.

$$P_r = \frac{\text{momentum diffusivity}}{\text{thermal diffusivity}}$$

38. Define Nusselts Number (Nu).

It is defined as the ratio of the heat flow by convection process under a unit temperature gradient to the heat flow rate by conduction under a unit temperature gradient through a stationary thickness (L) of meter.

39. Define Grashof number (Gr). [NOV/DEC 2017] / [April/May 2017]

It is defined as the ratio of product of inertia force and buoyancy force to the square of viscous force.

The significance of the Grashof number is that it represents the ratio between the buoyancy force due to spatial variation in fluid density (caused by temperature differences) to the restraining force due to the viscosity of the fluid.

40. Define Stanton number (St)

It is the ratio of Nusselt number to the product of Reynolds number and Prandtl number.

41. What is meant by Newtonian and non-Newtonian fluids?

The fluids which obey the Newton's law of viscosity are called Newtonian fluids and those which do not obey are called non-Newtonian fluids.

42. What is meant by laminar flow and turbulent flow?

Laminar flow:

Laminar flow is sometimes called stream line flow. In this type of flow, the fluid moves in layer and each fluid particle follows a smooth continuous path. The fluid particles in each layer remain in an orderly sequence without mixing with each other.

Turbulent flow:

In addition to the laminar type of flow, a distinct irregular flow is frequently observed in nature. This type of flow is called turbulent flow. The path of any individual particle is zigzag and irregular.

43. What is hydrodynamics boundary layer? [NOV/DEC 2017]

In hydrodynamics boundary layer, velocity of the fluid is less than 99% of free stream velocity.

44. What is thermal boundary layer? [NOV/DEC 2017]

In thermal boundary layer, temperature of the fluid is less than 99% of free stream temperature.

45. Define convection.

Convection is a process of heat transfer that will occur between a solid surface and a fluid medium when they are at different temperatures.

46. What is meant by free or natural convection? [NOV/DEC 2016]

If the fluid motion is produced due to change in density resulting from temperature gradients, the mode of heat transfer is said to be free or natural convection.

47. What is forced convection? [NOV/DEC 2016]

If the fluid motion is artificially created by means of an external force like a blower or fan, that type of heat transfer is known as forced convection.

48. What is the form of equation used to calculate transfer for flow through cylindrical pipes?

$$\text{Nu} = 0.023(\text{Re})^{0.8}(\text{Pr})^n$$

n = 0.4 for heating of fluids.

n=0.3 for cooling of fluids.

49. What are the dimensional parameters used in forced convection?

- Reynolds number (Re)
- Nusselt Number (Nu)
- Prandtl number (Pr)

50. Define boundary layer thickness.

The thickness of the boundary layer has been defined as the distance from the surface at which the local velocity or temperature reaches 99% of the external velocity or temperature.

51. Indicate the concept of significance of boundary layer.

In the boundary layer concept the flow field over a body is divided into two regions: A thin region near the body called the boundary layer where the velocity and the temperature gradients are large. The region outside the boundary layer where the velocity and the temperature gradients are very nearly equal to their free stream values.

52. Define displacement thickness.

The displacement thickness is the distance, measured perpendicular to the boundary, by which the free stream is displaced on account of formation of boundary layer.

53. Define momentum thickness.

The momentum thickness is defined as the distance through which the total loss of momentum per second be equal to if it were passing a stationary plate.

54. Define energy thickness.

The energy thickness can be defined as the distance, measured perpendicular to the boundary of the solid body, by which the boundary should be displaced to compensate for the reduction in kinetic energy of the flowing fluid on account of boundary layer formation.

55. List some characteristics of boundary layers [Nov/Dec 2017]

- A thin region near the body called the boundary layer where the velocity and temperature gradients are large.
- The region outside the boundary layer where velocity and temperature gradients are very nearly equal to their free stream values

56 .What is critical Reynolds number or the flow over flat plate? [Nov/Dec 2016]

It id measure the relative magnitude of the inertia force to the viscous force occurring in the flow.

56. How Reynolds and colburn analogies differ with each other. [April/ May 2017]

The main assumption is that heat flux q/A in a turbulent system is analogous to momentum flux τ , which suggests that the ratio $\tau/(q/A)$ must be constant for all radial positions.

UNIT III

PHASE CHANGE HEAT TRANSFER AND HEAT EXCHANGERS

57. Define boiling.

The change of phase from liquid to vapour state is known as boiling.

58. What is meant by condensation?

The change of phase from vapour to liquid state is known as condensation.

59. Give the application of boiling and condensation.

Boiling and condensation process finds wide application as mentioned below.

- Thermal and nuclear power point
- Refrigeration systems.
- Process of heating and cooling.
- Air conditioning system.

60. What is meant pool boiling? [NOV/DEC 2017]

If heat is added to a liquid from a submerged solid surface, the boiling process is referred to as pool boiling. In this case the liquid above the hot surface is essentially stagnant and it motion near the surface is due to free convection and mixing induced by bubble growth and detachment.

61. What are the modes of condensation?

There are two modes of condensation

- Film wise condensation.
- . Drop wise condensation

62. What is Film wise condensation?

The liquid condensate wets the solid surface, spread out and forms a continuous film over the entire surface is known as film wise condensation.

63. What is Drop wise condensation?

The vapour condenses into small liquid droplets of various sizes which fall down the surface in a random fashion.

64. What is heat exchange?

The heat exchange is defined as equipment which transfers the heat from a hot fluid to a cold fluid.

65. What are the types of heat exchanger?

The types of heat exchanger are as follows.

- Direct contact heat exchangers.
- Indirect contact heat exchangers
- Surface heat exchangers
- Parallel flow heat exchanger

66. What is meant by in direct contact heat exchangers?

In this type of heat exchangers, the transfer of heat between two fluids could be carried out by transmission through a wall which separates the two fluids.

67. What is meant by Regenerators?

In this type of heat exchangers, hot and cold fluids flow alternately through the same space.

Examples: IC engines, Gas turbine.

68. What is meant by Recuperators or surface heat exchangers?

This is the most common type of heat exchangers in which the hot and cold fluid do not come into direct contact with each other but are separated by a tube wall or a surface.

Examples: Automobile radiators, Air preheaters , economizers.

69. What is meant by parallel flow heat exchangers?

In this type of heat exchangers, hot and cold fluids move in the same direction.

70. What is meant by Counter flow heat exchangers?

In this type of heat exchangers, hot and cold fluids move in parallel but opposite direction.

71. What is meant by cross flow heat exchangers?

In this type of heat exchangers, hot and cold fluids move at right angles to each other.

72. What is meant by Shell and tube heat exchangers?

In this type of heat exchangers, one of the fluids moves through a bundle of tubes enclosed by a shell. The other fluid is forced through the shell and it moves over the outside surface of the tubes.

73. What is meant by Compact heat exchangers?

There are many special purpose heat exchangers called compact heat exchangers. They are generally employed when convection heat transfer co-efficient associated with one of the fluids is much smaller than that associated with the other fluid.

74. What is meant by LMTD? [NOV/DEC 2015]

We know that the temperature difference between the hot and cold fluids in the heat exchangers varies from point to point. In addition various modes of heat exchanger are involved. Therefore based on concept of appropriate mean temperature difference, also called logarithmic mean temperature difference.

75. What is meant Fouling factor? [NOV/DEC 2016]

We know, the surfaces of heat exchangers do not remain clean after it has been in use for some time .The surface become fouled with scaling or deposits .The effect of these deposits affecting the value of overall heat transfer co-efficient. This effect is taken care of by introducing an additional thermal resistance called fouling resistance.

76. What is meant by Effectiveness? [NOV/DEC 2014]

The heat exchanger effectiveness is defined as the ratio of actual heat transfer to the maximum possible heat transfer. $\epsilon = \text{actual heat transfer} / \text{maximum possible heat transfer}$.

77. What are the factors on which over all heat transfer coefficient depends? [Nov/Dec 2017]

- Heat transfer in engines
- Heat transfer in boiler
- Heat transfer in rocket nozzles
- Heat transfer in electric curve

78. Give example for pool boiling and flow boiling. [Nov/Dec 2016]

Pool boiling : The specific curve has been obtained from an electrically heated platinum wire submerged in a pool of water by varying its surface temperature and measuring the surface heat flux.

Flow boiling : This type of boiling occurs In water boilers involving forced convection.

79. What are fouling factors?

The surface heat exchanger do not remain clean after it has been in use for some time. The surface become fouled with sealing (or) deposited. The effects of these deposits affecting the values of overall heat transfer co-efficient (U) This effect is taken called of by introducing an additional thermal resistance called fouling factors.

80. Different pool boiling and forced convection boiling [Nov/Dec 2017]

Pool boiling	Forced convection
If heat is added to a liquid from a submerged solid surface, the boiling process is referred to as pool boiling. In this case the liquid above the hot surface is essentially stagnant and its motion near the surface is due to free convection and mixing induced by bubble growth and detachment.	Heat transfer in forced flow boiling is determined by both transfer of heat accumulated by vapor in the bubbles being broken off and by liquid convection. ... As the heat flux density grows, heat transfer enhances and the dependences for a shift upward.

**UNIT IV
RADIATION**

81. Define Radiation? [NOV/DEC 2017]

The heat transfer from one body to another without any transmitting medium is known as radiation .It is an electromagnetic wave phenomenon.

82. Define emissive power?

The emissive power is defined as the total amount of radiation emitted by a body per unit time and unit area .It is expressed in W/m^2 .

83. Define monochromatic emissive power. [MAY/JUNE2016] / [Nov/Dec 2016]

The energy emitted by the surface at a given length per unit time area in all direction is known as monochromatic emissive power.

84. What is meant by absorptivity?

Absorptivity is defined as the ratio between radiation absorbed and incident radiation.

85. What is meant by reflectivity?

Reflectivity is defined as the ratio of radiation reflected to the incident radiation.

86. What is meant by transmissivity

Transmissivity is defined as the ratio of radiation transmitted to the incident radiation.

87. What is black body?

Black body is an ideal surface having the following properties.1. A black body absorbs all incident radiation, regardless of wave length and direction.2. For a prescribed temperature and wave length, no surfaces can emit more energy than black body.

88. State Wien's displacement law.

Wien's displacement law gives the relationship between temperature and wave length corresponding to the maximum spectral emissive power of the black body at that temperature.

$$T_{\max} = C/\lambda$$

$$C = 2.9 \times 10^{-3}$$

$$T_{\max} = 2.9 \times 10^{-3} / \lambda \text{ mK}$$

89. State the Stefan –Boltzmann law.

The emissive power of a black body is proportional to the fourth power of absolute temperature.

$$E_b = \text{Emissive power W/m}^2$$

$$\text{Boltzmann constant} = 5.67 \times 10^{-8} \text{ W/m}^2\text{K}$$

90. Define Emissivity.

It is defined as the ability of the surface of a body to radiate heat. It is also defined as the ratio of emissive power of any body to the emissive power of a blackbody of equal temperature

91. What is meant by gray body?

If a body absorbs a definite percentage of incident radiation irrespective of their wave length, the body is known as gray body. The emissive power of a gray body is always less than that of the black body.

92. State Kirchoff's law of radiation.

This law states that the ratio of total emissive power to the absorptivity is constant for all surfaces which are in thermal equilibrium with the surrounding. It also states that the emissivity of the body is always equal to its absorptivity when the body remains in thermal equilibrium with its surroundings.

93. Define intensity of radiation (I_b).

It is defined as the rate of energy leaving a space in a given direction per unit solid angle per unit area of the emitting surface normal to the mean direction in space.

94. State Lambert's cosine law.[April/May 2017]

It states that the total emissive power E_b from a radiating plane surface in any direction is proportional to the cosine of the angle of emission.

95. What is the purpose of radiation shield?

Radiation shield constructed from low emissivity (high reflective) materials. It is used to reduce the net radiation transfer between two surfaces.

96. Define Irradiation (G)?

It is defined as the total radiation incident upon a surface per unit time per unit area. It is expressed in W/m^2

97. What is radiosity(J)? [Nov/Dec 2017]

It is used to indicate the total radiation leaving a surface per unit time per unit area. It is expressed in W/m^2 .

98. What are the assumptions made to calculate radiation exchange between the surfaces?

- All surfaces are considered to be either black or gray.
- Radiation and reflection process are assumed to be diffuse.
- The absorptivity of a surface is taken equal to the emissivity and independent of temperature of the source of the incident radiation

99. What is meant by shape factor and mention its physical significance.

The shape factor is defined as "The fraction of the radioactive energy that is diffused from one surface element and strikes the other surface directly with no intervening reflection" .it is represented by F_{ij} . Other names for radiation shape factor are view factor, angle factor and configuration factor .The shape factor is used in the analysis of radioactive heat exchange between two surfaces.

100. Discuss the radiation characteristics of carbon dioxide and water vapour.

The CO_2 and H_2O both absorb and emit radiation over certain wave length regions called absorption bands. The radiation in these gases is a volume phenomenon. The emissivity of CO_2 and the emissivity of H_2O at a particular temperature increase with partial pressure and mean beam length.

101.What are the properties of black body? [Nov/Dec 2017]

- A black body can absorb all incident radiation regardless of wavelength and direction
- For a prescribed temperature and wave length no surface can emit more energy than black body

102.What are the application of radiation shields? [April/May 2017]

- Radiation shields constructed from low emissivity (High reflective)materials
- It is used the net radiation transitory between two surfaces
- Net heat exchange between parallel plates without radiation shields.

103.What do you mean by infrared and ultraviolet radiation? [NOV/DEC2016]

- **infrared radiation** is a type of electro magnetic radiation, as are radio waves, ultraviolet radiation, X-rays and microwaves. Infrared (IR) light is the part of the EM spectrum that people encounter most in everyday life, although much of it goes unnoticed. It is invisible to human eyes, but people can feel it as heat.
- **ultraviolet radiation.** Radiation in the part of the electromagnetic spectrum where wavelengths are just shorter than those of ordinary, visible violet light but longer than those of x-rays.

UNIT V

MASS TRANSFER

104.What is mass transfer?

The process of transfer of mass a result of the species concentration difference in a mixture is known as mass transfer.

105.Give the examples of mass transfer.

- Humidification of air in cooling tower.
- Evaporation of petrol in the carburetor of an IC engine.
- The transfer of water vapour into dry air.

106.What are the modes of mass transfer? [Nov/Dec 2017]

- Diffusion mass transfer.
- Convective mass transfer.

107.What is molecular diffusion?

The transport of water on a microscopic level as a result of diffusion from a region of higher concentration to a region of lower concentration in a mixture of liquids or gases is known as molecular diffusion.

108.What is Eddy diffusion?

When one of the diffusion fluids is in turbulent motion, eddy diffusion takes place.

109.What is Convective mass transfer?

Convective mass transfer is a process of mass transfer that will occur between a surface and a fluid medium when they are at different concentrations.

110.State Fick's law of diffusion. [Nov/Dec 2016]

The diffusion rate is given by the Fick's law, which states that molar flux of an element per unit area is directly proportional to concentration gradient.

111.What is free Convective mass transfer?

If the fluid motion is produced due to change in density resulting from concentration gradient, the mode of mass transfer is said to be free or natural convective mass transfer.

Example: Evaporation of alcohol.

112.Define forced Convective mass transfer?

If the fluid motion is artificially created by means of an external force like a blower or fan, that type of mass transfer is known as convective mass transfer.

Example: The evaporation of water from an ocean when air blows over it

113 Define Schmidt Number?

It is defined as the ratio of the molecular diffusivity of momentum to the molecular diffusivity of mass

114.Define Scherwood number.

It is defined as the ratio of concentration gradient at the boundary.

115.Define Mass Concentration.

Mass of a component per unit volume of the mixture .It is expressed in kg/m³.13

116.Define Mass Concentration.

Mass of a component per unit volume of the mixture .It is expressed in kg/m³ 14

117.Define mass fraction.

The mass fraction is defined as the ratio of mass concentration of species to the total density of the mixture15

118.Define mole fractions.

The mole fraction is defined as the ratio of mole concentration of species to the total molar concentration.

119. Define mass transfer co-efficient [Nov/Dec2017]

It is the amount of total mass transfer rate on the surface area as per unit.

What are the difference mode of mass transfer? [Nov/Dec]

- Diffusion mass transfer
- Convection mass transfer

120. Distinguish between mass concentration and molar concentration. [April/May 2017]

Mass concentration : The mass of the component per unit volume of the mixture. Its is expressed in Kg/m^3

Molar concentration : The number of molecules of a component per unit volume of the mixture. It is expressed in Kg-mole/m^3

121. Give example of the free and forced convection mass transfer. [April/May 2017]

Free Convection Mass Transfer: If the fluid motion is produced due to change in density resulting from concentration gradients. The modes of mass transfer is said to be free or natural convection mass transfer.

Ex : Evaporation of alcohol

122. Define Schmidt number and state its physical significance. [NOV/DEC 2016]

It is defined as the ratio of the molecular diffusivity of momentum to the molecular diffusivity of mass.

$$SC = \nu / D_{ab}$$