SECOND TERM EXAMINATION, 2015

Q.1.(a)Explain the term-projection plane, projectors, center of projection.

Ans. A projection plane or plane of projection is a type of view in which graphical projections from an object intersect. Projection planes are used often in descriptive geometry and graphical representation. A picture plane in perspective drawing is a type of projection plane.

Projection lines travelling between object point and the viewer are called projectors.

The projection from a point onto a plane or central projection is called the center of projection.

Q.1.(b) Write three differences between lossless and lossy compression techniques.

Ans.

Lossless Compression	**Lossy Compression**
1. In lossless compression, every single bit of data that was originally in the file remains after the file is uncompressed.	1. Lossy compression reduces a file by permanently eliminating certain information, especially redundant information
2. All of the information is completely restored.	2. When the file is uncompressed, only a part of the original information is still there (although the user may not notice it).
3. This is generally the technique of choice for text or spreadsheet files, where losing words or financial data could pose a problem.	3. It is generally used for video and sound, where a certain amount of information loss will not be detected by most users.
4. The Graphics Interchange File (GIF) is an image format used on the Web that provides lossless compression.	4. JPEG image file, commonly used for photographs and other complex still images on the Web, is an image that has lossy compression. Using JPEG compression, the creator can decide how much loss to introduce and make a trade-off between file size and image quality.

Q.1.(c) Explain the terms-illumination model and surface rendering? What is calculated first and why?

Ans. The contribution from the light that goes directly from the light source and is reflected from the surface is called a "local illumination model". So, for a local illumination model, the shading of any surface is independent from the shading of all other surfaces.

A "global illumination model" adds to the local model the light that is reflected from other surfaces to the current surface. A global illumination model is more comprehensive, more physically correct, and produces more realistic images. It is also more computationally expensive. We will first look at some basic properties of light and color, the physics of light-surface interactions, local illumination models, and global illumination models.

Surface rendering involves the careful collection of data on a given object in order to create a three- dimensional image of that object on a computer. It is an important technique used in a variety of industries.

One of the techniques to construct an image using surface rendering is with illumination. An illumination model shines a light on a surface and makes calculations based on the intensity of the light reflected back. This collects enough specific data to create a 3-D image later.

Q.2.(a) What is meant by visible surface detection? What are the two types of surface detection methods? Explain any one of the Object Space Method.

Ans. Visible Surface Detection is the problem of deciding which elements of a rendered screen are visible, and which are hidden.

Object Space: Space object algorithm have the advantage of retaining the relevant data and because of this ability the interaction of a algorithm with the object becomes easier. The calculation done for the color is done only once. Object space algorithms also allow shadow generation to increase the depth of the 3- dimensional objects on the screen. The incorporation algorithm is done in software and it is difficult to implement them in hardware.

- Image space algorithms are much more efficient than object space algorithms.
- Object space algorithms are much more functional than image space algorithms.
- Color calculation in object space algorithms is done only one time and is retained by it but in image space algorithm the calculation once done is over written later.

Z-buffering, also known as depth buffering, is the management of image depth coordinate in 3-D graphics, usually done in hardware, sometimes in software. It is one solution to the visibility problem 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.

Q.2.(b) What is a vanishing point? How many principal vanishing points exists?

Ans. A vanishing point is a point in the picture plane that is the intersection of the projection(or drawings) of a set of parallel lines in space on to the picture plane. When the set of parallels is perpendicular to the picture plane, the construction is known as one –point perspective and their vanishing point corresponds to the oculus or eye point from which the image should be viewed for correct perspective geometry.

Any number of vanishing points is possible in a drawing, one for each set of parallel lines that are at an angle relative to the plane of the drawing.

Q.3.(a) What is drawback of Gourand Shading? How it is rectified by another shading technique.

Ans. Phong shading refers to an interpolation technique for surface shading in 3-D computer graphics. It is also called Phong interpolation or normal-vector interpolation shading. Specifically, it interpolates surface normals across rasterized polygons and computer pixel colors based on the specific combination of Phong shading may also refer to the specific combination of Phong interpolation and the Phong reflection model.

Phong shading improves upon Gourand Shading and provides a better approximation of the shading of a smooth surface. Phong shading assumes a smoothly varying surface normal vector. The Phong interpolation method works better than Gourand shading when applied to a reflection model that has small specular highlights such as the Phong reflection model.

The most serious problem with Gourand shading occurs when specular highlights are found in the middle of a large polygon. Since these specular highlights are absent from the polygon's vertices and Gourand shading interpolation based on the vertex colors, the specular highlights will be missing from the polygon's interior. This problem is fixed by Phong shading.

Unlike Gourand shading, which interpolation colors across polygons, in Phong shading a normal vector is linearly interpolation across the surface of the polygon from the polygon's vertex normals. The surface normal is interpolated and normalized at each pixel and then used in a reflection model, e.g. the Phong reflection model, to obtain the final pixel color. Phong shading is more computationally expensive than Gourand shading since the reflection model must be computed at each pixel instead of at each vertex.

In modern graphics hardware, variants of this algorithm are implemented using pixel or fragment shaders.

Q.3.(b) What is JPEG? Explain the four modes of operation of JPEG briefly.

Ans. JPEG is a lossy compression technique for color images. Although it can reduce files sizes to about 5% of their normal size, some detail is lost in the compression.

i. The sequential DCT mode of operation, where the picture is scanned in the same way as in part one
ii. The progressive DCT mode of operation, where the picture is displayed in its entirely concurrently with the transmission of the bit stream, at first imperfect and then gradually improving.
iii. The lossless mode of operation, where the file is only compressed, with no data lost by cosine transforms or quantization.
iv. The hierarchical DCT mode of operation, where the picture is stored at multiple resolutions for different uses, in such a way that the lower-resolution images are stored with supplementary data which can be added on to produce higher-resolution images as required.

Q.4.(a) Obtain the projection matrix of an object on Z=d plane and the center of projection is(0,0,d). Also notify the type of perspective projection.

Ans. Z=d is parallel to xy plane.

Thus, the view plane normal vector N is the same as the normal vector k to the xy plane i.e. N=k

Choosing the reference point as Ro (0,0,d)

$$N\ (n1, n2, n3) = (0,0,1)$$

$$Ro = (Xo, Yo, Zo) = (0,0,d)$$

$$Do = n1Xo+n2Yo+n3Zo = d$$

Projection matrix is

$$\begin{matrix} D & 0 & 0 & 0 \\ 0 & D & 0 & 0 \\ 0 & 0 & D & 0 \\ 0 & 0 & 1 & 0 \end{matrix}$$

Q.4.(b) Why do we compress the data? Explain any one of the compression technique.

Ans. **Huffman Code:** Huffman Code assigns shorter encodings to elements with a high frequency, F:e. It differs from block encoding I that it is able to assign codes of different bit lengths to different elements. Elements with the highest frequency, F:e , get assigned the shortest bit length code. The key to decompressing Huffman code is a Huffman tree.

A Huffman tree is a special binary tree called a trie. A binary trie is a binary tree in which a 0 represents a left branch and a 1 represents a right branch. The numbers on the nodes of the binary trie represent the total frequency, F:e , of the tree below. The leaves of the trie represent the elements, e , to be encoded. The elements are assigned the encoding which corresponds to their place in the binary trie. Below is an example.

Message to be encoded

dad ade fade bead ace dead cab bad fad café face

Block Encoding

011 000 011 000 011 100 000 011 101 001 100 000 011 000 010 100 011 100 000 011 010 000 001 001 000 011 101 000 011 010 000 101 100 101 000 010 100

The block encoding above is a fixed length encoding. if a message contains I elements, block encoding requires log I bits to encode each element, e.

Spaces have been inserted between the strings of bits which represent each character in both the Block Encoding and the Huffman Encoding.

Huffman Encoding

Huffman Encoding:

01 10 01 10 01 111 110 10 01 111 000 111 10 01 10 001 111 10 01 001 10 000 000 10 01 110 10 01 001 10 001 111 110 10 001 111

Element	Frequency	Block Code	Huffman Code
a	11	000	10
b	3	001	000
c	4	010	001
d	9	011	01
e	7	100	111
f	4	101	110

Entropy: The average information content of a message is called its entropy. The information content is related to uncertainty. The less likely a message is to occur the larger its information content. This makes sense if we think of an example: if a person knows what message is about to be sent to him, how new information has he learned by receiving that message? None. This is all that the above statement is saying.

Entropy , E, is information content. The entropy of a source is inversely propotional to its probability of occurrence:

$$E = -\log P$$

We use the log function because we are converting all sources into the binary alphabet, B.

The same rule applies to an element, e, in a message, M. its entropy can be defined as:

$$E:e + -\log (P:e)$$

P:e is the probability of an element in a message. It is equal to that element's frequency, F:e, divided by the frequency of the entire message, F:M:

$$P{:}e = F{:}E/F{:}M$$

The average information content or average entropy for a message, E:M, can now be defined. We know the entropy for each element in the message is E:e. we will index the elements, e, in a message, M , by assigning them integer positions, I, according to their place in the message. For example: the first element, e, in message M will be assigned 1, the second will be assigned 2… the ith will be assigned i. now we can define the entropy for an entire message, E:M, where there are t elements:

$$E{:}M = (P{:}1*E) + (P{:}2*E{:}2) + (P{:}3*E{:}3)+\ldots\ldots..+(P{:}i*E{:}i)$$

Entropy is an important concept to data compression. The entropy of an element (E:e) is the minimum number of bits needed to encode that a element. The entropy of an entire message (E:M) is the minimum number of bits needed to encode the entire message with a lossless compression. The entropy of a message can be used to determine if data compression is worth attempting. It can also be used to evaluate the effectiveness of a compression. The number of bits in a compressed code can be compressed code can be compared to the entropy for the message (E:M) revealing how close to optimal compression one's compressed code is.