V.S.B COLLEGE OF ENGINEERING TECHNICAL CAMPUS, COIMBATORE

DEPARTMENT OF ELECTRICAL AND ELECTRONICS ENGINEERING

III EEE-VI Semester all subjects 2 & 16 marks QP

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COMMUNICATION ENGINEERING
UNIT I
ANALOG COMMUNICATION

1. Define amplitude Modulation.

Amplitude Modulation is the process of changing the amplitude of a relatively high frequency carrier signal in proportion with the instantaneous value of the modulating signal.

2. Define Modulation index and percent modulation for an AM wave.

Modulation index is a term used to describe the amount of amplitude change present in an AM waveform .It is also called as coefficient of modulation. Mathematically modulation index is

$m = Em/ Ec$

Where m = Modulation coefficient

Em = Peak change in the amplitude of the output waveform voltage.

Ec = Peak amplitude of the unmodulated carrier voltage.

Percent modulation gives the percentage change in the amplitude of the output wave when the carrier is acted on by a modulating signal.

3. Define Low level Modulation.

In low level modulation, modulation takes place prior to the output element of the final stage of the transmitter. For low level AM modulator class A amplifier is used.

4. Define High level Modulation.

In high level modulators, the modulation takes place in the final element of the final stage where the carrier signal is at its maximum amplitude. For high level modulator class C amplifier is used.

5. What is the advantage of low level modulation?

An advantage of low level modulation is that less modulating signal power is required to achieve a high percentage of modulation.

6. Distinguish between low level and high level modulation.

In low level modulation, modulation takes place prior to the output element of the final stage of the transmitter.It requires less power to achieve a high percentage of modulation.

In high level modulators, the modulation takes place in the final element of the final stage where the carrier signal is at its maximum amplitude and thus, requires a much higher amplitude modulating signal to achieve a reasonable percent modulation.

7. Define image frequency.

An image frequency is any frequency other than the selected radio frequency carrier that ,if allowed to enter a receiver and mix with the local oscillator ,will produce a cross product frequency that is equal to the intermediate frequency.

8. Define Local Oscillator tracking.

Tracking is the ability of the local oscillator in a receiver to oscillate either above or below the selected radio frequency carrier by an amount equal to the intermediate frequency throughout the entire radio frequency band.

9. Define High side injection tracking.

In high side injection tracking , the local oscillator should track above the incoming RF carrier by a fixed frequency equal to fRF +fIF .

Define Low side injection tracking.

In low side injection tracking ,the local oscillator should track below the RF carrier by a fixed frequency equal to fRF -fIF .

11. Define tracking error.How it is reduced.

The difference between the actual local oscillator frequency and the desired frequency is called tracking error.It is reduced by a technique called three point tracking.

12. Define image frequency rejection ratio.

The image frequency rejection ratio is the measure of the ability of pre selector to reject the image frequency. Mathematically ,IFRR is IFRR =(1+Q2r2)1/2

Where r= (fim/fRF)-(fRF/fim)

13. Define Heterodyning.

Heterodyne means to mix two frequencies together in a nonlinear device or to translate one frequency to another using nonlinear mixing.

23 What are the disadvantages of conventional (or) double side band full carrier system?

In conventional AM ,carrier power constitutes two thirds or more of the total transmotted power.This is a major drawback because the carrier contains no information ;the sidebands contain the information . Second ,conventional AM systems utilize twice as much bandwidth as needed with single sideband systems.

15. Define Single sideband suppressed carrier AM.

AM Single sideband suppressed carrier is a form of amplitude modulation in which the carrier is totally suppressed and one of the sidebands removed.

16. Define AM Vestigial sideband.

AM vestigial sideband is a form of amplitude modulation in which the carrier and one complete sideband are transmitted,but only part of the second sideband is transmitted.

17.What are the advantages of single sideband transmission?

The advantages of SSBSC are

1.Power conservation: Normally ,with single side band transmission ,only one sideband is transmitted and the carrier is suppressed. So less power is required to produce essentially the same quality signal.

2.Bandwidth conservation: Single sideband transmission requires half as much bandwidth as conventional AM double side band transmission.

3.Noise reduction: Because a single side band system utilizes half as much bandwidth as conventional AM,the thermal noise power is reduced to half that of a double side band system.

18. What are the disadvantages of single side band transmission?

1. Complex receivers: Single side band systems require more complex and expensive receivers than conventional AM transmission .

23 Tuning Difficulties: Single side band receivers require more complex and precise tuning than conventional AM receivers.

19. Define direct frequency modulation.

In direct frequency modulation , frequency of a constant amplitude carrier signal is directly proportional to the amplitude of the modulating signal at a rate equal to the frequency of the modulating signal.

20. Define indirect frequency Modulation.

In indirect frequency modulation ,phase of a constant amplitude carrier directly proportional to the amplitude of the modulating signal at a rate equal to the frequency of the modulating signal.

21. Define instantaneous frequency deviation.

The instantaneous frequency deviation is the instantaneous change in the frequency of the carrier and is defined as the first derivative of the instantaneous phase deviation.

22. Define frequency deviation.

Frequency deviation is the change in frequency that occurs in the carrier when it is acted on by a modulating signal frequency. Frequency deviation is typically given as a peak frequency shift in Hertz(Do).The peak to peak frequency deviation (2Df) is sometimes called carrier swing.The peak frequency deviation is simply the product of the deviation sensitivity and the peak modulating signal voltage and is expressed mathematically as Df=K1 Vm Hz

23. State Carson rule.

Carson rule states that the bandwidth required to transmit an angle modulated wave as twice the sum of the peak frequency deviation and the highest modulating signal frequency. Mathematically carson's rule is B=2(Df +fm) Hz.

24. Define Deviation ratio.

Deviation ratio is the worst case modulation index and is equal to the maximum peak frequency deviation divided by the maximum modulating signal frequency. Mathematically ,the deviation ratio is
DR= Df (max) fm(max)

25. What is multiplexing?

Multiplexing is the transmission of information from one or more source to one or more destination over the same transmission mediam.

UNIT II

DIGITAL COMMUNICATION

31. Define transmission line.

A transmission line is a metallic conductor system that is used to transfer electrical energy from one point to another. A transmission line is two or more conductors separated by an insulator, such as a pair of wires or a system of wire pairs.

32. Define balanced transmission line.

In balanced transmission line, both conductors carry current; one conductor carries the signal and the other is the return. This type of transmission is called differential or balanced signal transmission.

33. Define unbalanced transmission line.

In unbalanced transmission line, one wire is at ground potential where as the other wire is at signal potential. This type of transmission is called single ended or unbalanced signal transmission.

34. Define Open wire transmission line.

An open wire transmission line is a two wire parallel conductor. It consists simply of two parallel wires, closely spaced and separated by air. Nonconductive spacers are placed at periodic intervals for support and to keep the dielectric between the conductors constant. The dielectric is simply the air between and around the two conductors in which the TEM wave propagates.

5888 What are the advantages of open wire transmission line?

0 Simple in construction
1 Radiation losses are high
2 It is susceptible to noise pickups.

23 Define twisted pair cable.

are cabled into cores. The cores are covered with various types of sheaths neighboring pairs are twisted with different pitch to reduce interference between pairs due to mutual conduction.

37. Define shielded cable transmission line.

In shielded cable transmission line, parallel two wire transmission lines are enclosed in a metallic conductive metal braid to reduce the radiation losses and interference. The metal braid is connected to ground acts as shield. The braid also prevents signal radiation from reaching the conductors.

38. Define concentric transmission line.

Coaxial or concentric conductors are used for high frequency applications to reduce losses and to isolate transmission paths. The basic coaxial cable consists of a center conductor surrounded by a concentric conductor. At high frequencies, the coaxial outer conductor provides excellent shielding against external interference.

39. Describe the electrical and physical properties of a transmission line.

The electrical properties of a transmission line are wire conductivity and insulator dielectric constant. The physical properties are wire diameter and conductor spacing.

40. List and describe the four primary constants of a transmission line.

The primary constants of a transmission line are series dc resistance, series inductance, shunt capacitance, and shunt conductance. The primary constants are uniformly distributed through out the length of the line and therefore are commonly called distributed parameters.

41. List the secondary constants of a transmission line.

Secondary constants of a transmission line are _ Characteristic impedance. _ Propagation constant

42. Define characteristic impedance for a transmission line.

Characteristic impedance is defined as the impedance seen looking into an infinitely long line or the impedance seen looking into a finite length of line that is terminated in a purely resistive load equal to the characteristic impedance of the line. It is also called as surge impedance.

43. Define propagation constant.

Propagation constant is used to express the attenuation (signal loss) and the phase shift per unit length of a transmission line. It is also called as propagation coefficient.

44. Define velocity factor for a transmission line.

Velocity factor (sometimes called velocity constant) is defined as the ratio of the actual velocity of propagation through free space. Mathematically the velocity factor is Vf=vp/c

Where vf= velocity factor
Vp=actual velocity of propagation

C=velocity of propagation through free space(3X108 m/s)

45. List and describe five types of transmission line losses.

Transmission line losses are conductor loss, radiation loss, dielectric heating loss, coupling loss, and corona.

46. Describe an incident wave, reflected wave.

An ordinary transmission line is bidirectional; power can propagate equally well in both directions. Voltage that propagates from the source toward the load is called incident voltage, and the voltage that propagates from the load toward the source is called reflected voltage.

47. Define resonant line.

A transmission line with no reflected power is called a flat or resonant line.

48. Define nonresonant transmission line.

A transmission line is nonresonant if it is of finite length or if it is terminated with a resistive load equal in ohmic value to the characteristic impedance of the transmission line.

49. Define reflection coefficient.

The reflection coefficient (sometimes called the coefficient of reflection) is a vector quantity that represents the ratio of reflected voltage to incident voltage or reflected current to incident current .Mathematically ,the reflection coefficient is gamma, _ , defined by _=Er/Ei (or)
Ir/Ii Where _=reflection coefficient (unitless)
Ei =incident voltage (volts)
Er =reflected voltage (volts)
Ir = reflected current (amps)
Ii =incident current (amps)

50. Define matched line.

When Zo=ZL, all the incident power is absorbed by the load .This is called a matched line. Where Zo=characteristic impedance
ZL= load impedance

51. Define unmatched line.

When Zo _ ZL, some of the incident power is absorbed by the load and some is returned to the source. This is called an unmatched or mismatched line. Where Zo=characteristic impedance
ZL= load impedance

52. Define standing wave.

In unmatched line, some of the incident power is absorbed by the load and some is returned to the source. So there are two electromagnetic waves, traveling in opposite

direction present on the line at the same time. The two traveling waves setup an interference pattern known as standing wave.

53. Define standing wave ratio.

The standing wave ratio is defined as the ratio of the maximum voltage to the minimum voltage (or) the maximum current to the minimum current of a standing wave on a transmission line.SWR is often called the voltage standing wave ratio (VSWR).

SWR= Vmax
Vmin

54. Define ground wave propagation.

A ground wave is an electromagnetic wave that travels along the surface of earth. Therefore ground waves are sometimes called surface waves. Ground waves must be vertically polarized.

55.What are the disadvantages of ground wave propagation?
1.Ground waves require relatively high transmission power.
2.Ground waves are limited to very low, low, and medium frequencies, requiring large antennas.
58.What are the advantages of ground wave propagation?

23 Ground waves are relatively unaffected by changing atmospheric conditions. 2. If the transmitted power is large enough, then ground wave propagation can be used to communicate between any two points in the world.

57.Define space wave propagation.

Space wave propagation of electromagnetic energy includes radiated energy that travels in the lower few miles of earth's atmosphere. Space waves include both direct and ground reflected waves. Direct waves travel essentially in a straight line between the transmit and receive antennas. space wave propagation with direct waves is commonly called line of sight transmission.

58.**Define sky waves.**

Electromagnetic waves that are directed above the horizon level are called sky waves.
58. Define critical frequency.

The critical frequency is defined as the highest frequency that can be propagated directly upward and still be returned to earth by the ionosphere.

59. Define virtual height.

Virtual height is the height above earth's surface from which a refracted wave appears to have been reflected.

60. Define maximum usable frequency.

Maximum usable frequency is the highest frequency that can be used for sky wave propagation between two specific points on earth's surface.

UNIT III

SOURCE CODES, LINE CODES & ERROR CONTROL

61.**What are the advantages of digital transmission?**

a. The advantage of digital transmission over analog transmission is noise immunity. Digital pulses are less susceptible than analog signals to variations caused by noise.

23 Digital signals are better suited to processing and multiplexing than analog signals.

24 Digital transmission systems are more noise resistant than the analog transmission systems.

25 Digital systems are better suited to evaluate error performance.

62.What are the disadvantages of digital transmission?

_ The transmission of digitally encoded analog signals requires significantly more bandwidth than simply transmitting the original analog signal.

_ Analog signal must be converted to digital codes prior to transmission and converted back to analog form at the receiver, thus necessitating additional encoding and decoding circuitry.

63. Define pulse code modulation.

In pulse code modulation, analog signal is sampled and converted to fixed length, serial binary number for transmission. The binary number varies according to the amplitude of the analog signal.

64. What is the purpose of the sample and hold circuit?

The sample and hold circuit periodically samples the analog input signal and converts those samples to a multilevel PAM signal.

65. What is the Nyquist sampling rate?

Nyquist sampling rate states that, the minimum sampling rate is equal to twice the highest audio input frequency.

66. Define and state the causes of fold over distortion.

The minimum sampling rate(fs) is equal to twice the highest audio input frequency(fa).If fs is less than two times fa ,distortion will result. The distortion is Called aliasing or fold over distortion. The side frequencies from one harmonic fold over into the sideband of another

harmonic. The frequency that folds over is an alias of the input signal hence ,the names “aliasing” or “fold over distortion” .

67. Define overload distortion.

If the magnitude of sample exceeds the highest quantization interval, overload distortion occurs.

68. Define quantization.

Quantization is a process of approximation or rounding off. Assigning PCM codes to absolute magnitudes is called quantizing.

69. Define dynamic range.

Dynamic range is the ratio of the largest possible magnitude to the smallest possible magnitude. Mathematically, dynamic range is

$$DR = \frac{V_{max}}{V_{min}}$$

70. Define coding efficiency.

Coding efficiency is the ratio of the minimum number of bits required to achieve a certain dynamic range to the actual number of PCM bits used. Mathematically, coding efficiency is

Coding efficiency= Minimum number of bits (including sign bit) X 100 Actual number of bits(including sign bit)

71. Define companding.

Companding is the process of compressing, then expanding. With companded systems, the higher amplitude analog signals are compressed prior to transmission, then expanded at the receiver.

72. Define slope overload. How it is reduced.

The slope of the analog signal is greater than the delta modulator can maintain, and is called slope overload. Slope overload is reduced by increasing the clock frequency and by increasing the magnitude of the minimum step size.

73. Define granular noise. How it is reduced.

When the original input signal has relatively constant amplitude, the reconstructed signal has variations that were not present in the original signal. This is called granular noise.
Granular noise can be reduced by decreasing the step size.

74. Define adaptive delta modulation.

Adaptive delta modulation is a delta modulation system where the step size of the AC is automatically varied depending on the amplitude characteristics of the analog input signal.

75. Define peak frequency deviation for FSK.

Peak frequency deviation (_f) is the difference between the carrier rest frequency and either the mark or space frequency and either the mark or space frequency. (_f)=_fm-fs_2

76. Define modulation index for FSK.

The modulation index in FSK is defined as

h = (_f) fa

where h= FM modulation index called the h factor in FSK fa = fundamental frequency of the binary modulating signal (_f) = Peak frequency deviation (hertz)

5888 Define bit rate.

In digital modulation, the rate of change at the input to the modulator is called the bit rate (fb) and has the unit of bits per second (bps).

78. Define Baud rate.

The rate of change at the output of the modulator is called baud.

79. Define QAM.

Quadrature amplitude modulation is a form of digital modulation where the digital information is contained in both the amplitude and phase of the transmitted carrier.

5888 Write the relationship between the minimum bandwidth required for an FSK system and the bit rate.

The minimum bandwidth can be approximated as B=2_f +2fb Where B=minimum bandwidth (hertz)
_f=minimum peak frequency deviation (hertz)
Fb=bitrate

UNIT IV
MULTIPLE ACCESS TECHNIQUES

81. Define data communication codes.

Data communication codes are prescribed bit sequences used for encoding characters and symbols.

82. Define error detection.

Error detection is simply the process of monitoring the received data and determining when a transmission has occurred.

83. Define Echoplex.

Echoplex is a relatively simple type of error detection scheme that is used almost exclusively in data communications systems where human operators are used to enter the data manually from a keyboard.

84. Describe serial interface.

Serial interface is used to ensure an orderly flow of data between the line control unit and the modem.

85. Define parallel interface.

Parallel interfaces transfer data between two devices eight or more bits a time. That is one entire data word is transmitted at a time .Parallel transmission is sometimes referred to as serial by word transmission.

86. What are the advantages of parallel transmission?

The advantage of parallel transmission is data are transmitted much faster than with serial transmission because there is a transmission path for each bit of the word. In parallel interface there is no need to convert data from parallel to serial or vice versa.

87. What is the purpose of data modem?

The primary purpose of data modem is to interface computers, computer networks, and other digital terminal equipment to analog communication lines and radio terminals.

88. Classify data modems.

Data modems are generally classified in to synchronous and asynchronous data modems.

89. Define OSI.

The term open system interconnection is the name for a set of standards for communications among computers. The primary purpose of OSI standards is to serve as a structural guideline for exchanging information between computers, terminals and networks.

0 What are the advantages of bus topology?

0 The bus topology is easy to understand, install, and use for small networks.

b. The cabling cost is less as the bus topology requires the least amount of cable to connect the computers.

c. The bus topology is easy to expand by joining two cables with a BNC barrel connector.

d. In the expansion of bus topology repeaters are used to boost the signal and increase the distance.

5888 What are the disadvantages of star topology?

One disadvantage of a star topology is that the network is only as reliable as the central node. When the central node fails, the entire system fails.

92. Describe LAN.

A local area network is usually a privately owned and links the devices in a single office, building or campus of up to a few kilometers in size.

93. Define LAN topology.

The topology or physical architecture of a LAN identifies how the stations are interconnected.

94. What are the seven layers of open system interconnection?

The seven layers of open system interconnection
are _ Physical layer
_ Data link layer
_ Network layer
_ Transport layer
_ Session layer
_ Presentation layer
_ Application layer

UNIT V
SATELLITE, OPTICAL FIBER – POWERLINE, SCADA

95. Define satellite.

Satellite is a celestial body that orbits around a planet.In aerospace terms, a satellite is a space vehicle launched by humans and orbits earth or another celestial body.

96. State Kepler's first law.

Kepler's first law states that a satellite will orbit a primary body following an elliptical path.

97. State Kepler's second law.

Kepler's second law states that for equal time intervals of time a satellite will sweep out equal areas in the orbital plane, focused at the bary center.

98. State Kepler's third law.

The third law states that the square of the periodic time of orbit is proportional to the cube of the mean distance between the primary and the satellite.

99. Define orbital satellite.

Orbital satellites are also called as nonsynchronous satellite.Nonsynchronous satellites rotate around earth in an elliptical or circular pattern. In a circular orbit, the speed or rotation is constant however in elliptical orbits the speed depends on the height the satellite is above the earth.

100. Define prograde orbit.

If the satellite is orbiting in the same direction as earth's rotation and at an angular velocity greater than that of earth, the orbit is called a prograde (or) posigrade orbit.

101. Define retrograde orbit.

If the satellite is orbiting in the opposite direction as the earth's rotation or in the same direction with an angular velocity less than that of earth, the orbit is called a retrograde orbit.

102. Define Geo synchronous satellite.

Geo synchronous or geo stationary satellites are those that orbit in a circular pattern with an angular velocity equal to that of Erath. Geosynchronous satellites have an orbital time of approximately 24 hours, the same as earth; thus geosynchronous satellites appear to be stationary as they remain in a fixed position in respect to a given point on earth.

103. Define apogee and perigee.

The point in an orbit which is located farthest from the earth is called apogee.
The point in an orbit which is located closest to earth is called perigee.

104. Define angle of inclination.

The angle of inclination is the angle between the earth's equatorial plane and the orbital plane of a satellite measured counterclockwise at the point in the orbit where it crosses the equatorial plane traveling from south to north.

105. Define Decending node.

The point where a polar or inclined orbit crosses the equatorial plane traveling from south to north. This point is called descending node.

106. Define ascending node.

The point where a polar or inclined orbit crosses the equatorial plane traveling from north to south is called ascending node.

107. Define line of nodes.

The line joining the ascending and descending nodes through the center of earth is called line of nodes.

108. Define angle of elevation.

Angle of elevation is the vertical angle formed between the direction of travel of an electromagnetic wave radiated from an earth station antenna pointing directly toward a satellite and the horizontal plane.

109. Define Azimuth angle.

Azimuth is the horizontal angular distance from a reference direction, either the southern or northern most point of the horizon.

0 **What are the advantages of optical fiber communication?** _ Greater information capacity
_ Immunity to crosstalk

_ Immunity to static interference
_ Environmental immunity
_ Safety
_ Security

111. Define a fiber optic system.

An optical communications system is an electronic communication system that uses light as the carrier of information. Optical fiber communication systems use glass or plastic fibers to contain light waves and guide them in a manner similar to the way electromagnetic waves are guided through a waveguide.

112. Define refractive index.

The refractive index is defined as the as the ratio of the velocity of propagation of light ray in free space to the velocity of propagation of a light ray in a given material. Mathematically, the refractive index is
n = c/_
where c = speed of light in free space
_ = speed of light in a given material

113. Define critical angle.

Critical angle is defined as the minimum angle of incidence at which a light ray may strike the interface of two media and result in an angle of refraction of 90°or greater.

114. Define single mode and multi mode propagation.

If there is only one path for light to take down the cable, it is called single mode.
If there is more than one path ,it is called multimode.

115. Define acceptance angle.

It defines the maximum angle in which external light rays may strike the air/fiber interface and still propagate down the fiber with a response that is no greater than 10 dB below the maximum value.

116. Define numerical aperture.

Numerical aperture is mathematically defined as the sine of the maximum angle a light ray entering the fiber can have in respect to the axis of the fiber and still propagate down the cable by internal reflection.

117. Define modal dispersion.

Modal dispersion or pulse spreading is caused by the difference in the propagation times of light rays that take different paths down a fiber. Modal dispersion can occur only in multimode fibers.It can be reduced by using single mode step index fibers and graded index fibers.

0 What are the advantages of heterojunction LEDs?

a. The increase in current density generates a more brilliant light spot. b. The smaller emitting area makes it easier to couple its emitted light into fiber.

c. The small effective area has a smaller capacitance, which allows the planar heterojunction LED to be used at higher speeds.

0 What are the disadvantages of injection laser diode?

_ ILDs are typically on the order of 10 times more expensive than LEDs

_ Because ILDs operate at higher powers, they typically have a much shorter life time than LEDs.
_ ILDs are more temperature dependent than LEDs.

PART – B
UNIT-I

1 Name the methods used for the suppression of unwanted side band in AM transmission? Discuss the working of any one of them.
0 Compare the features of FM with AM. Also write the merits and demerits of FM.
1 Discuss the Armstrong method of FM generation
4.Describe the working of direct and indirect method of generation of FM signal
5. Discuss in detail about the working of a SSB transmitter and receiver.
6.(i) plain the method of generating a single sideband signal using balance modulators (ii) Discuss the principle of AM based radio frequency receiver with block diagram
7 .Explain with neat circuit, generation of AM wave. For an AM DSBFC modulator with carrier frequency fc = 100 KHz and a maximum modulating signal fm = 5 KHz, determine bandwidth and sketch the output frequency spectrum.
8 Solve the expression for the amplitude modulated wave and its power relation and give the time and frequency domain representation of AM wave.
9 . Develop an expression for a narrow band FM wave
0 Demonstrate with neat diagram about the operation of a super heterodyne receiver.

PART – B
UNIT-II

1.A PCM system has the following parameters: a maximum analog input frequency of 4 KHz a maximum decoded voltage at the receiver of ±2.55 V, and a minimum dynamic range of 46dB.

Calculate the following: (i) Minimum sample rate (ii) Minimum number of bits used in the PCM code (iii) Resolution (iv) Quantization error

0 (i) Discuss on the process ”Companding” and its characteristics.

0 How does Flat top sampling differ from natural sampling? Illustrate and obtain the filtered output?

1 Explain QPSK with a block diagram and spectrum and discuss the phasor diagram for sinusoids. Also Develop the expression for its bit error Probability.

2 Describe in detail about the operation of a ASK and BSK with neat diagram.

5888 .(i) Describe the working of a Delta modulation system.

What is meant by quantization and develop an expression for quantization noise in PCM and DM systems

0 (i) Discuss the generation method of PWM. Explain how you will convert PWM to PPM with diagram (ii) Describe the working of pulse code modulation system with its block diagram

1 (i) Explain Frequency shift keying method with equations. (ii) Discuss the method of modulation and demodulation in MSK with equations and block diagrams.

2 Discuss DPCM technique with neat block diagram. For minimum line speed with an 8 bit PCM for speech signal ranging upto 1 volt. Calculate the resolution and quantization error. Calculate the coding efficiency for a resolution of 0.01 volt with the 8 bit PCM.

3 List the advantages of data communication and explain GMSK and QAM techniques with neat diagram.

0 With a neat block diagram, explain BPSK transmitter. Also analyze the bandwidth considerations of BPSK.

UNIT-III
PART – B

1 For the given 8 bit stream 11010100, plot the NRZ, RZ, AMI, HDBP and Differential Manchester codes.

2.Describe about the viterbi algorithm by showing the possible path through the trellis of a coder. Assume the state diagram of any coder

0 (i) Discuss the Bandwidth-SNR trade off of a communication system.(BT-2) (4) (ii) Apply the following coding technique and obtain the output wave form for the bit stream 10011100 on NRZ, RZ, AMI, HDBP, ABQ and MBnB.

1 (i) Design a convolutional coder of constraint length 6 and rate efficiency ½.(BT-6) (4) (ii) State and prove Shannon noiseless coding theorem. (BT-1) (12) 5 (i) Given states S={S0,S1,S2,S3,S4} and their probabilities P={0.4,0.2,0.2,0.1,0.1}. Find coding efficiency and entropy for Huffman coding.

0 Give the procedure for Shannon Fano coding and use the procedure to obtain the code for the source symbols S0, S1, S2, S3, S4, S5 with their respective probabilities ½, 1/3, 1/12, 1/15, 1/120, 1/120.

Discuss the concept of coding and decoding methods of block codes with its mathematical framework and diagram.7 (i) Explain Bandwidth-SNR trade off in source coding

Explain various types of Leni coding techniques.

(i) Describe the concept of noiseless coding theorem and state its significance. (ii) Describe in detail about error control codes and their applications. (BT-1) (8) 9 Evaluate the Block check sequence (BCS) for the following data and cyclic redundancy check(CRC) generating polynomials: data $G(x) = x7 + x5 + x4 + x2 + x1 + x0$, CRC $P(x) = x5 + x4 + x1 + x0$. Also Explain the Concept of block codes and coding efficiency.

0 (i) Explain in detail about various error control codes with one example for convolution code. (ii) Show the plots for the polar, unipolar, bipolar and Manchester NRZ line code format for an information {1 0 11 0 0}.

UNIT-IV
PART – B

1.500users employ FDMA to transmit 1000-bit packets of data. The channel band width is 100MHz and QPSK is used at each of the 5000 carrier frequencies employed (i) What is the maximum bandwidth allocated to each user? (ii) What is the bit rate employed by each user? (iii) How long does it take to transmit a packet?

2.Describe briefly about the operation of a typical TDMA system with the time pattern.

Explain the principle of FDMA with diagram.

0 Describe CDMA technique in detail.

5 .Discuss TDMA technique in detail and compare it with FDMA.

6 .Compare various multiple access techniques used in wireless communication with their merits and demerits.

7 Explain with a neat block diagram the SDMA technique

Illustrate how interference is avoided by using code division multiplexing.

ÀrĀ□Ā∀Ġ□Ā□Ā□Ā□Ā□Ā□Ā□ĀÀrĀ□Ā∀Ġ□Ā□Ā□Ā□Ā□Ā□0 Describe briefly about wired and wireless communication systems.

0 .Discuss the BSC and BEC with their channel diagram and transition matrix.

UNIT-V
PART – B

1 Describe briefly and compare the three types of optical fiber configurations.

2 Discuss in detail about the frequency reuse concept of cellular network. Support your answer with the required diagram.

3.Discuss broadly on the multiple access techniques used in satellite communication.

4..Describe the following. (i) Optical detectors and their types. (ii) Satellite types. (iii) Digital filters used in satellite systems. (iv) Optical link

0 (i) An X band transponder of a geo synchronous satellite at a height of 35760 km from the surface of the earth and operating at 7.6 GHz has its antenna oriented towards earth station antenna. The input power and directive gain of the transponder antenna are 18 W and 36dB respectively. Assuming no losses occurring in the down link determine (1) Power received by earth station antenna of aperture diameter and efficiency given as 3 meters and 62% respectively. (2) EIRP of the transponder antenna (6) (ii) Write notes on SCADA and Intelsat.

0 (i) What are the modes of operation suggested in optical fibres? How are optical fibres classified according to this? Discuss elaborately. (ii) State the advantages of Fiber optic communication.

1 (i) Explain with the block diagram of an earth station. (ii) Explain in detail about the aperture actuators used in satellites

0 (i) Illustrate Kepler's law and how they relate to satellite communication.

1 Illustrate the significance of satellite link budgets s and how they are calculated.

5888 (i) Draw the block diagram of a satellite uplink model and explain its operation.

5888 Discuss power line carrier communication with suitable example and diagram.

11.(i) Explain the concept of satellite communication system and its application (ii) Explain in detail about the operation of any one fiber optic source and detector.

SOLID STATE DRIVES
UNIT – I
TWO MARKS

1. What is meant by electrical drives?

Systems employed for motion control are called drives and they employ any of the prime movers such as diesel or petrol engines, gas or steam turbines, hydraulic motors and electric motors for supplying mathematical energy for motion control. Drives employing electric motion are called electric drives.

2. What are the requirements of an electric drive?

Stable operation should be assured.
The drive should have good transient response

3. Specify the functions of power modulator.

Power modulator performs one or more of the following four functions.

Modulates flow of power form the source to the motor in such a manner that motor is imparted speed-torque characteristics required by the load.

During transient operations, such as starting, braking and speed reversal, it restricts source and motor currents within permissible values; excessive current drawn from source may overload it or may cause a voltage dip.

Mention the different types of drives.

1) Group drive 2) Individual drive
0 Multimotor drive

0 List the different types of electrical drives.

1) dc drives 2) ac drives

6. What are the advantages of electric drives?

They have flexible control characteristics. the steady state and dynamic characteristics of electrical drives can be shaped to satisfy load requirements.

0 Drives can be provided with automatic fault detection systems, programmable logic controllers and computers can be employed to automatically ctrl the drive operations in a desired sequence.

1 They are available in which range of torque, speed and power.

2 It can operate in all the four quadrants of speed-torque plane. Electric braking gives smooth deceleration and increases life of the equipment compared to other forms of braking.

3 Control gear required for speed control, starting and braking is usually simple and easy to operate.

7. What are the functions performed by electric drives?

Various functions performed by electric drives include the following.

Driving fans, ventilators, compressors and pumps etc.

Lifting goods by hoists and cranes

Imparting motion to conveyors in factories, mines and warehouses and

Running excavators and escalators, electric locomotives, trains, cars, trolley buses, lifts and drums winders etc.

8. What are the disadvantages of electric drives?

The disadvantages of electric drives are

0 Electric drives system is tied only up to the electrified area.

1 The condition arising under the short circuits, leakage from conductors and breakdown of overhead conductor may lead to fatal accidents.

2 Failure in supply for a few minutes may paralyses the whole system.

0 What are the advantages of group drive over individual drive?

The advantages of group drive over individual drive are

0 Initial cost: Initial cost of group drive is less as compared to that of the individual drive.

1 Sequence of operation: Group drive system is useful because all the operations are stopped simultaneously.

2 Space requirement: Less space is required in group drive as compared to individual drive.

0 Low maintenance cost: It requires little maintenance as compared to individual drive.

10. What the group drive is not used extensively.

Although the initial cost of group drive is less but yet this system is not used extensively because of following disadvantages.

ÀrĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□ĀĀÀrĀÀĀrĀ□Ā□Ā□Ā□Ā□Ā□0 Power factor: Group drive has low power factor

ÀrĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□ĀĀÀrĀÀĀrĀ□Ā□Ā□Ā□Ā□Ā□1 Efficiency: Group drive system when used and if all the machines are not working together the main motor shall work at very much reduced load.

0 Reliability: In group drive if the main motor fails whole industry will come to stand still.

0.0 Flexibility: Such arrangement is not possible in group drive i.e., this arrangement is not suitable for the place where flexibility is the prime factor.

0.1 Speed: Group drive does not provide constant speed.

0 Types of machines: Group drive is not suitable fro driving heavy machines such as cranes, lifts and hoists etc.

23 Write short notes on individual electric drives.

In individual drive, each individual machine is driven by a separate motor. This motor also imparts motion to various other parts of the machine. Examples of such machines are single spindle drilling machines (Universal motor is used) and lathes. In a lathe, the motor rotates the spindle, moves the feed and also with the help of gears, transmits motion to lubricating and cooling pumps. A three phase squirrel cage induction motor is used as the drive. In many such applications the electric motor forms an integral part of the machine.

0 Mention the different factors for the selection of electric drives?

0.0 Steady state operation requirements.
0.1 Transient operation requirements.
0.2 Requirements related to the source.
0.3 Capital and running cost, maintenance needs life.
0.4 Space and weight restriction.
0.5 Environment and location.

7) Reliability.

13.Mention the parts of electrical drives.

0 Electrical motors and load.
1 Power modulator
2 Sources
3 Control unit
4 Sensing unit

0 Mention the applications of electrical drives

Paper mills
Electric traction Cement mills
Steel mills

1 Mention the types of enclosures

Screen projected type
Drip proof type
Totally enclosed type

16. Mention the different types of classes of duty

Continuous duty, Discontinuous duty, Short time duty, intermittent duty.

17. What is meant by regenerative braking?

Regenerative braking occurs when the motor speed exceeds the synchronous speed. In this case the IM runs as the induction m\c is converting the mechanical power into electrical power which is delivered back to the electrical system. This method of braking is known as regenerative braking.

18. What is meant by dynamic braking?

Dynamic braking of electric motors occurs when the energy stored in the rotating mass is dissipated in an electrical resistance. This requires a motor to operate as a gen. to convert the stored energy into electrical.

19. What is meant by plugging?

It is one method of braking of IM. When phase sequence of supply of the motor running at the speed is reversed by interchanging connections of any two phases of stator with respect to supply terminals, operation shifts from motoring to plugging region.

20. What is critical speed?

It is the speed that separates continuous conduction from discontinuous conduction mode.

21. Which braking is suitable for reversing the motor?

Plugging is suitable for reversing the motor.

22. Define equivalent current method

The motor selected should have a current rating more than or equal to the current. It is also necessary to check the overload of the motor. This method of determining the power rating of the motor is known as equivalent current method.

23. Define cooling time constant

It is defined as the ratio between C and A. Cooling time constant is denoted as Tau. Tau = C/A Where C=amount of heat required to raise the temp of the motor body by 1 degree Celsius A=amount of heat dissipated by the motor per unit time per degree Celsius.

0 **What are the methods of operation of electric drives?** Steady state
Acceleration including starting
Deceleration including starting

1 Define four quadrant operations.

The motor operates in two mode: motoring and braking. In motoring, it converts electrical energy into mechanical energy which supports its motion. In braking, it works as a generator, converting mathematical energy into electrical energy and thus opposes the motion. Motor can provide motoring and braking operations for both forward and reverse directions.

26. What is meant by mechanical characteristics?

The curve is drawn between speed and torque. This characteristic is called mechanical characteristics.

27. Mention the types of braking

Regenerative braking
Dynamic braking Plugging

0 **What are the advantage and disadvantages of D.C. drives?**

The advantages of D.C. drives are,

a. Adjustable speed
0.0 Good speed regulation
0.1 Frequent starting, braking and reversing.

The disadvantage of D.C. drives is the presence of a mechanical commutator which limits the maximum power rating and the speed.

0 Give some applications of D.C. drives.

The applications of D.C. drives are,

a. Rolling mills	b. Paper mills	c. Mine winders	d. Hoists
e. Machine tools	f. Traction	g. Printing presses	h. Excavators
i. Textile mils	j. Cranes		

30. Why the variable speed applications are dominated by D.C. drives?

The variable speed applications are dominated by D.C. drives because of lower cost, reliability and simple control.

UNIT – II
TWO MARKS

1. What is the use of flywheel? Where it is used?

It is used for load equalization. It is mounted on the motor shaft in compound motor.

0What are the advantages of series motor?

The advantages of series motors are,

a. High starting torque

3.Define and mention different types of braking in a dc motor?

In breaking the motor works as a generator developing a negative torque which opposes the motion. Types are regenerative braking, dynamic or rheostat braking and plugging or reverse voltage braking.

5888 How the D.C. motor is affected at the time of starting?

A D.C. motor is started with full supply voltage across its terminals, a very high current will flow, which may damage the motor due to heavy sparking at commuter and heating of the winding. Therefore, it is necessary top limit the current to a safe value during starting.

5. List the drawbacks of armature resistance control?

In armature resistance control speed is varied by wasting power in external resistors that are connected in series with the armature. since it is an inefficient method of speed control it was used in intermittent load applications where the duration of low speed operations forms only a small proportion of total running time.

6. What is static Ward-Leonard drive?

Controlled rectifiers are used to get variable d.c. voltage from an a.c. source of fixed voltage controlled rectifier fed dc drives are also known as static Ward-Leonard drive.

7. What is aline commutated inverter?

Full converter with firing angle delay greater than 90 deg. is called line commutated inverter. such an operation is used in regenerative braking mode of a dc motor in which case a back emf is greater than applied voltage.

Mention the methods of armature voltage controlled dc motor? When the supplied voltage is ac,
Ward-Leonard schemes

Transformer with taps and un controlled rectifier bridge Static Ward-Leonard scheme or controlled rectifiers **when the supply is dc:**
Chopper control

0 How is the stator winding changed during constant torque and constant horsepower operations?

For constant torque operation, the change of stator winding is made form series - star to parallel - star, while for constant horsepower operation the change is made from series-delta to parallel-star. Regenerative braking takes place during changeover from higher to lower speeds.

10. Define positive and negative motor torque.

Positive motor torque is defined as the torque which produces acceleration or the positive rate of change of speed in forward direction. Positive load torque is negative if it produces deceleration.

11. Write the expression for average o/p voltage of full converter fed dc drives?
Vm=(2Vm/pi)cospi ..... continuous conduction
Vm=[Vm(cos alpha-cos beta)+(pi+alpha+beta)]/pi] discontinuous conduction

12. What are the disadvantages of conventional Ward-Leonard schemes?

Higher initial cost due to use of two additional m\cs. Heavy weight and size.

Needs more floor space and proper foundation. Required frequent maintenance

13. Mention the drawbacks of rectifier fed dc drives?

Distortion of supply. Low power factor. Ripple in motor current

14. What are the advantages in operating choppers at high frequency?

The operation at a high frequency improves motor performance by reducing current ripple and eliminating discontinuous conduction.

15. Why self commutated devices are preferred over thyristors for chopper circuits?

Self commutated devices such as power MOSFETs power transistors, IGBTs, GTOs and IGCTs are preferred over thyristors for building choppers because they can be commutated by a low power control signal and don't need commutation circuit.

16. State the advantages of dc chopper drives?

DC chopper device has the advantages of high efficiency, flexibility in control, light weight, small size, quick response and regeneration down to very low speed.

17. What are the advantages of closed loop c of dc drives?

Closed loop control system has the adv. of improved accuracy, fast dynamic response and reduced effects of disturbance and system non-linearities.

0 What are the types of control strategies in dc chopper?

0 Time ratio control.
1 Current limit control.

1 What are the adv. of using PI controller in closed loop ctrl. of dc drive?

Stabilize the drive

0 Adjust the damping ratio at the desired value

1 Makes the steady state speed error close to zero by integral action and filters out noise again due to the integral action.

2 What are the different methods of braking applied to the induction motor?

Regenerative braking Plugging, Dynamic braking.

3 What are the different methods of speed control of IM?

Stator voltage control, Supply frequency control, Rotor resistance control, Slip power recovery control.

0 What is meant by stator voltage control.?

The speed of the IM can be changed by changing the stator voltage. Because the torque is proportional to the square of the voltage.

23. Mention the application of stator voltage control.

This method is suitable for applications where torque demand reduced with speed, which points towards its suitability for fan and pump drives.

24. Mention the applications of ac drives.

AC drives are used in a no. of applications such as fans, blowers, mill run-out tables, cranes, conveyors, traction etc.

25. What are the three regions in the speed-torque characteristics in the IM?

Motoring region (0<=s<=1) Generating region(s<0)
Plugging region (1<=s<=2) where s is the slip.

0 What are the advantages of stator voltage control method?

ÀrÃ□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã뜀ǰ□Ã□Ã□Ã□Ã□Ã□Ã0 The control circuitry is simple
ÀrÃ□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã뜀ǰ□Ã□Ã□Ã□Ã□Ã□Ã1 Compact size
ÀrÃ□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã뜀ǰ□Ã□Ã□Ã□Ã□Ã□Ã2 Quick response time

ÀrÃ□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã□Ã뜀ǰ□Ã□Ã□Ã□Ã□Ã□Ã3 There is considerable savings in energy and thus it is economical method as compared to other methods of speed ctrl.

1 What is meant by soft start?

The ac voltage controllers show a stepless control of supply voltage from zero to rated voltage they are used for soft start for motors.

0 List the adv of squirrel cage IM?

0 Cheaper
1 light in weight
2 Rugged in construction
3 More efficient
4 Require less maintenance
5 It can be operated in dirty and explosive environment

1 Define slip

The difference between the synchronous speed (Ns)and actual speed(N)of the rotor is known as slip speed. the % of slip is gn by,

%slip s=[(Ns-N)/Ns]x 100

30. Define base speed.
The synchronous speed corresponding to the rated freq is called the base speed.

UNIT – III

TWO MARKS

1. What is meant by frequency control of IM?

The speed of IM can be controlled by changing the supply freq because the speed is directly proportional to supply frequency. This method of speed ctrl is called freq control.

2. What is meant by V/F control l?

When the freq is reduced the i/p voltage must be reduced proportionally so as to maintain constant flux otherwise the core will get saturated resulting in excessive iron loss and magnetizing current. This type of IM behavior is similar to the working of dc series motor.

0 What are the advantages of V/F control?

0 Smooth speed ctrl
1 Small i/p current and improved power factor at low freq. start

2 Higher starting torque for low case resistance

3. What is meant by stator current control?

The 3 phase IM speed can be controlled by stator current control. The stator current can be varied by using current source inverter.

23 What are the 3 modes of region in the adjustable-freq IM drives characteristics?

23 Constant torque region
24 Constant power region
25 High speed series motoring region

24 What are the two modes of operation in the motor?

The two modes of operation in the motor are, motoring and braking. In motoring, it converts electrical energy to mechanical energy, which supports its motion. In braking, it works as a generator converting mechanical energy to electrical energy and thus opposes the motion.

7. How will you select the motor rating for a specific application?

When operating for a specific application motor rating should be carefully chosen that the insulation temperature never exceed the prescribed limit. Otherwise either it will lead to its immediate thermal breakdown causing short circuit and damage to winding, or it will lead to deterioration of its quality resulting into thermal breakdown in near future.

8. What is braking? Mention its types.

The motor works as a generator developing a negative torque which opposes the motion is called barking.
It is of three types. They are,

23 Regenerative braking.
24 Dynamic or rheostat braking.
25 Plugging or reverse voltage braking.

23 **What are the three types of speed control?**
The three types of speed control as,

23 Armature voltage control
24 Field flux control

5888 Armature resistance control.

0 What are the advantages of armature voltage control?

The advantages of armature voltage control are,

a. High efficiency
b. Good transient response
c. Good speed regulation.

11. What are the methods involved in armature voltage control? When the supply in A.C.

0 Ward-Leonard schemes
1 Transformer with taps and an uncontrolled rectifier bridge.
2 Static ward Leonard scheme or controlled rectifiers when the supply in D.C.
3 Chopper control.

0 Give some drawbacks and uses of Ward-Leonard drive.

The drawbacks of Ward . Leonard drive are.

a. High initial cost b. Low efficiency

The Ward-Leonard drive is used in rolling mills, mine winders, paper mills, elevators, machine tools etc.

0 Give some advantages of Ward-Leonard drive.

The advantages of Ward-Leonard drive are,

23 Inherent regenerative barking capability
24 Power factor improvement.

14. What is the use of controlled rectifiers?

Controlled rectifiers are used to get variable D.C. Voltage form an A.C. Source of fixed voltage.

15. What is known as half-controlled rectifier and fully controlled rectifier?

The rectifiers provide control of D.C. voltage in either direction and therefore, allow motor control in quadrants I and IV. They are known as fully-controlled rectifiers.

The rectifiers allow D.C. Voltage control only in one direction and motor control in quadrant I only. They are known as half-controlled rectifiers.

16. What is called continuous and discontinuous conduction?

A D.C. motor is fed from a phase controlled converter the current in the armature may flow in discrete pulses in called continuous conduction.

A D.C. motor is fed from a phase controlled converter the current in the armature may flow continuously with an average value superimposed on by a ripple is called discontinuous conduction.

23 What are the three intervals present in discontinuous conduction mode of single phase half and fully controlled rectifier?

The three intervals present in half controlled rectifier are,
Duty interval

b. Free, wheeling interval c. Zero current intervals.

0.0 Duty interval
0.1 Zero current intervals.

What is called inversion?

Rectifier takes power from D.C. terminals and transfers it to A.C. mains is called inversion.

0 What are the limitations of series motor? Why series motor is not used in traction applications now a days?

0 The field of series cannot be easily controlled. If field control is not employed, the series motor must be designed with its base speed equal to the highest desired speed of the drive.

1 Further, there are a number of problems with regenerative braking of a series motor. Because of the limitations of series motors, separately excited motors are now preferred even for traction applications.

1 What are the advantages of induction motors over D.C. motors?

The main drawback of D.C. motors is the presence of commutate and brushes, which require frequent maintenance and make them unsuitable for explosive and dirty environments. On the other hand, induction motors, particularly squirrel-cage are rugged, cheaper, lighter, smaller, more efficient, require lower maintenance and can operate in dirty and explosive environments.

21. Give the applications of induction motors drives.

Although variable speed induction motor drives are generally expensive than D.C. drives, they are used in a number of applications such as fans, blowers, mill run-out tables, cranes, conveyors, traction etc., because of the advantages of induction motors. Other applications involved are underground and underwater installations, and explosive and dirty environments.

22. How is the speed controlled in induction motor?

The induction motor speed can be controlled by supplying the stator a variable voltage, variable frequency supply using static frequency converters. Speed control is also possible by feeding the slip power to the supply system using converters in the rotor circuit, basically one distinguishes two different methods of speed control.

0 Speed control by varying the slip frequency when the stator is fed from a constant voltage, constant frequency mains.

1 Speed control of the motor using a variable frequency variable voltage motor operating a constant rotor frequency.

23 **How is the speed control by variation of slip frequency obtained?**

Speed control by variation of slip frequency is obtained by the following ways.

a. Stator voltage control using a three-phase voltage controller.

b. Rotor resistance control using a chopper controlled resistance in the rotor circuit.

c. Using a converter cascade in the rotor circuit to recover slip energy.

d. Using a cyclconverter in the rotor circuit.

5888 Mention the effects of variable voltage supply in a cage induction motor.

When a cage induction motor is fed from a variable voltage for speed control the following observations may be made.

a. The torque curve beyond the maximum torque point has a negative shape. A stable operating point in this region is not possible for constant torque load.

b. The voltage controlled must be capable of withstanding high starting currents. The range of speed control is rather limited.

c. The motor power factor is poor.

25. Classify the type of loads driven by the motor.

The type of load driven by the motor influences the current drawn and losses of the motor as the slip various. The normally occurring loads are

2. Constant torque loads.
3. Torque varying proportional to speed.
4. Torque varying preoperational to the square of the speed.

26. What are the disadvantages of constant torque loads?

The constant torque loads are not favored due to increase in the losses linearly with slip and becoming maximum at s= 1.0. This is obvious form the variation of flux as the voltage is varied for speed control. To maintain constant torque the motor draws heavy current resulting in poor torque/ampere, poor efficiency ad poor power factor at low speeds.

0 In which cases, torque versus speed method is suitable. Torque versus speed method is suitable only for the following cases.

0 For short time operations where the duration of speed controls ids defined.

1 For speed control of blowers or pumps having parabolic or cubic variations of torque with speed. This is not suitable for constant torque loads due to increases and heating.

28. How is the speed of a squirrel cage induction motor controlled?

The speed of a squirrel cage induction motor can be controlled very effectively by varying the stator frequency. Further the operation of the motor is economical and efficient, if it operates at very small slips. The speed of the motor is therefore, varied by varying the supply frequency and maintaining the rotor frequency at the rated value or a value corresponding to the required torque on the linear portion of the torque-speed curve.

29. Why the control of a three-phase indication motor is more difficult than D.C. motors.

The control of a three-phase induction motor, particularly when the dynamic performance involved is more difficult than D.C. motors. This is due to a. Relatively large internal resistance of the converter causes voltage fluctuations following load fluctuations because the capacitor cannot be ideally large.

0 In a D.C. motor there is a decoupling between the flux producing magnetizing current and torque producing armature current. They can be independently controlled. This is not the case with induction motors.

1 An induction motor is very poorly damped compared to a D.C. motor.

23 Where is the V/f control used?

The V/f control would be sufficient in some applications requiring variable torque, such as centrifugal pumps, compressors and fans. In these, the torque varies as the square of the speed. Therefore at small speeds the required torque is also small and V/f control would be sufficient to drive these leads with no compensation required for resistance drop. This is true also for the case of the liquid being pumped with minimal solids.

UNIT – IV

TWO MARKS

1. What are the components of the applied voltage to the induction motor?

The applied voltage to the induction motor has two components at low frequencies. They are
a. Proportional to stator frequency.
b.To compensate for the resistance drop in the stator.
The second component deepens on the load on the motor and hence on rotor frequency.

2. What is indirect flux control?

The method of maintaining the flux constant by providing a voltage boost proportional to slip frequency is a kind of indirect flux control. This method of flux control is not desirable if very good dynamic behaviour is required.

3. What is voltage source inverter?

Voltage source inverter is a kind of D.C. link converter, which is a two stage conversion device.

4. What is the purpose of inductance and capacitance in the D.C. link circuit?

The inductance in the D.C. link circuit provides smoothing whereas the capacitance maintains the constancy of link voltage. The link voltage is a controlled quality.

5. What are the disadvantages of square wave inverter in induction motor drive?

Square wave inverters have commutation problems at very low frequencies, as the D.C. link voltage available at these frequencies cannot charge the commutating capacitors sufficiently enough to commutate the thrusters. Those puts a limit on the lower frequency of operation. To extend the frequency towards zero, special charging circuits must be used.

6. What is slip controlled drive?

When the slip is used as a controlled quantity to maintain the flux constant in the motor the drive is called slip enrolled drive. By making the slip negative (i.e., decreasing the output frequency of the inverter) The machine may be made to operate as a generator and the energy of the rotating parts fed back to the mains by an additional line side converter or dissipated in a resistance for dynamic barking. By keeping the slip frequency constant, braking at constant torque and current can be achieved. Thus braking is also fast.

7. What are the effects of harmonics in VSI fed induction motor drive?

The motor receives square wave voltages. These voltage has harmonic components. The harmonics of the stator current cause additional losses and heating. These harmonics are also responsible for torque pulsations. The reaction of the fifth and seventh harmonics with the fundamental gives rise to the seventh harmonic pulsations in the torque developed. For a given induction motor fed from a square wave inverter the harmonic content in the current tends to remain constant independent of input frequency, with the rang of operating frequencies of the inverter.

8. What is a current source inverter?

In a D.C. link converter, if the D.C. link current is controlled, the inverter is called a current source inverter, The current in the D.C. link is kept constant by a high inductance and he capacitance of the filter is dispensed with . A current source inverter is suitable for loads which present a low impedance to harmonic currents and have unity p.f.

9. Explain about the commutation of the current source inverter.

The commutation of the inverter is load dependent. The load parameters form a part of the commutation circuit. A matching is therefore required between the inverter and the motor. Multimotor operation is not possible. The inverter must necessarily be a force commutated one as the induction motor cannot provide the reactive power for the inverter. The motor voltage is almost sinusoidal with superimposed spikes.

10. Give the features from which a slip controlled drive is developed.

The stator current of an induction motor operating on a variable frequency, variable voltage supply is independent of stator frequency if the air gap flux is maintained constant. However, it is a function of the rotor frequency. The torque developed is also a function of rotor frequency. The torque developed is also a function of rotor frequency only. Using these features a slip controlled drive can be developed employing a current source inverter to feed an induction motor.

11. How is the braking action produced in plugging?

In plugging, the barking torque is produced by interchange any two supply terminals, so that the direction of rotation of the rotating magnetic field is reversed with respect to the rotation of the motor. The electromagnetic torque developed provides the braking action and brings the rotor to a quick stop.

12. Where is rotor resistance control used?

Where the motors drive loads with intermittent type duty, such as cranes, ore or coal unloaders, skip hoists, mine hoists, lifts, etc. slip-ring induction motors with speed control by variation of resistance in the rotor circuit are frequently used. This method of speed control is employed for a motor generator set with a flywheel (Ilgner set) used as an automatic slip regulator under shock loading conditions.

13. What are the advantages and disadvantages of rotor resistance control?

Advantage of rotor resistance control is that motor torque capability remains unaltered even at low speeds. Only other method which has this advantage is variable frequency control. However, cost of rotor resistance control is very low compared to variable frequency control.

Major disadvantage is low efficiency due to additional losses in resistors connected in the rotor circuit.

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16. How is the resistance in the output terminals of a chopper varied?

The resistance connected across the output terminals of a chopper can be varied form O to R by varying the time ratio of the chopper. When the chopper is always OFF, the supply is always connected to the resistance R. The time ratio in this case is zero and the effective resistance connected in R. Similarly when the chopper is always ON, the resistance is short circuited. The time ratio in the case is unity and the effective resistance connected is 0. Hence by varying the time ratio from 0 to 1, the value of resistance can be varied from R to O.

23 What is the function of inductance L and resistance R in the chopper resistance circuit?

A smoothing inductance L is used in the circuit to maintain the current at a constant value. Any short circuit in the chopper does not become effective due to L.

The value of R connected across the chopper is effective for all phases and its value can be related to the resistance to be connected in each phase if the conventional method has been used. The speed control range is limited by the resistance.

23 What are the disadvantages and advantages of chopper controlled resistance in the rotor circuit method?

The method is very inefficient because of losses in the resistance. It is suitable for intermittent loads such as elevators. At low speeds, in particular the motor has very poor efficiency. The rotor current is non-sinusoidal. They harmonics of the rotor current produce torque pulsations. These have a frequency which is six times the slip frequency.
Because of the increased rotor resistance, the power factor is better.

19. How is the range of speed control increased?

The range of speed control can be increased if a combination of stator voltage control and rotor resistance control is employed. Instead of using a high resistance rotor, a slip ring rotor with external rotor resistance can be used when stator voltage control is used for controlling the speed.

20. Why the static scherbius drive has a poor power factor?

Drive input power is difference between motor input power and the power fed back. Reactive input power is the sum of motor and inverter reactive power. Therefore, drive has a poor power factor throughout the range of its options.

21. How is super synchronous speed achieved?

Super synchronous speed can be achieved if the power is fed to the rotor from A.C. mains. This can be made possible by replacing the converter cascade by a cycloconverter. A

cycloconverter allows power flow in either direction making the static sherbets drive operate at both sub and supper synchronous speeds.

22. Give the features of static scherbius drive

The torque pulsations and other reactions are minimal. The performance of the drive improves with respect to additional losses and torque pulsations. A smooth transition is possible from sub to super synchronous speeds without any commutation problems. Speed reversal is not possible. A step up transformer may be interposed between the lines and the converter, to reduce the voltage rating of the converter.

23. Where is Kramer electrical drive system used?

Some continuous rolling mills, large air blowers, mine ventilators, centrifugal pumps and any other mechanisms including pumps drives of hydraulic dredgers require speed adjustment in the range from 15 to 30% below or above normal. If the induction motor is of comparatively big size

(100 to 200 KW) it becomes uneconomical to adjust speed by mean's pf external resistances due to copper losses as slip power is wasted as heat in the retort circuit resistance. In these case , the Kramer electrical drive system is used , where slip power recovery takes places.

24. What is the use of sub synchronous converter cascades?

Sub synchronous converter cascades have been used, till now, in applications requiring one quadrant operation. These can be employed for drives where at least one electrical barking

is required. A four quadrant operation can also be made possible in these cascades, using suitable switching.

25. How is the speed control obtained in static Kramer drive?

For speed control below synchronous speed, the slip power is pumped back to the supply, where as for the case of speed above synchronous speed, additional slip power is injected into the rotor circuit.

26. What is static Kramer drive?

Instead of wasting the slip power in the rotor circuit resistance, it can be converted to 60 Hz A.C. and pumped back to the line. The slip power controlled drive that permits only a sub synchronous range of speed control through a converter cascade is know as static Kramer drive.

27. What is the use and functions of step down transformer is static Kramer drive?

For a restricted speed range closer to synchronous speed, the system power factor can be further improved by using a step -down transformer.

The step-down transformer has essentially two functions: besides improving the line power factor, it also helps to reduce the converter power ratings.

28. What are the advantages of static Kramer drive?

The static Kramer drive has been very popular in large power pump and fan-type drives, where the range of speed control is limited near, but below the synchronous speed. The drive system is very efficient and the converted power rating is low because t has to handle only the slip power, In fact, the power rating becomes lower with a more restricted range of speed control. The additional advantages are that the drive system has D.C. machine like characteristics and the control is very simple.

29. What are the causes of harmonic currents in static Kramer drive?

The rectification of slip power causes harmonic currents in the rotor, and these harmonics are reflected to the stator by the transformer action of the machine. The harmonic currents are also injected into the A.C. line by the inverter. As a result, the machine losses are increased and some amount of harmonic torque is produced. Each harmonic current in the rotor will create a reading magnetic filed and its direction of rotation will depend on the order pf the harmonic.

UNIT – V
TWO MARKS

1. Give the four modes of operation of a Scherbius drive

The four modes of operation of static Scherbius drive are, Sub synchronous motoring.
Sub synchronous regeneration Super synchronous motoring Super synchronous regeneration

2. Give the use of synchronous motors.

Synchronous motors were mainly used in constant speed applications. The development of semiconductor variable frequency sources, such as inverters and cycloconverters, has allowed their use in draft fane, main line traction, servo drives, etc.

3. How are the stator and rotor of the synchronous motor supplied?

The stator of the synchronous motor is supplied from a thyristor power converter capable of providing a variable frequency supply. The rotor, depending upon the situation, may be constructed with slip rings, where it conforms to a conventional rotor. It is supplied with D.C. through slip rings. Sometimes rotor may also be free from sliding contacts (slip rings), in which case the rotor is fed from a rectifier rotating with rotor.

4. What is the difference between an induction motor and synchronous motor?

An induction motor operates at lagging power factor and hence the converter supplying the same must invariable is a force commutated one. A synchronous motor, on the other hand, can be operated at any power factor by controlling the field current.

23 **List out the commonly used synchronous motors**. Commonly used synchronous motors are,

- 23 Wound field synchronous motors.
- 24 Permanent magnet synchronous motors
- 25 Synchronous reluctance synchronous motors.
- 26 Hysterias motors.

23 Mention the main difference between the wound field and permanent magnet motors.

When a wound filed motor is started as an induction motor, D.C. field is kept off. In case of a permanent magnet motor, the field cannot be 'turned off'.

7. Give the advantages and applications of PMSM.

a. High efficiency b. High power factor c. Low sensitivity to supply voltage variations.
The application of PMSM is that it is preferred of industrial applications with large duty cycle such as pumps, fans and compressors.

8. Give the uses of a hysteresis synchronous motor.

Small hysteresis motors are extensively used in tape recorders, office equipment and fans. Because of the low starting current, it finds application in high inertia application such as gyrocompasses and small centrifuges.

9. Mention the two modes employed in variable frequency control

Variable frequency control may employ and of the two modes. a. True synchronous mode b. Self-controlled mode

10. Define load commutation
Commutation of thyristors by induced voltages pf load is known as load commutation.

11. List out the advantages of load commutation over forced commutation.

Load commutation has a number of advantages over forced commutation It does not require commutation circuits
Frequency of operation can be higher
It can operate at power levels beyond the capability of forced commutation.

12. Give some application of load commutated inverter fed synchronous motor drive.

Some prominent applications of load commutated inverter fed synchronous motor drive are high speed and high power drives for compressors, blowers, conveyers, steel rolling mills, main-line traction and aircraft test facilities.

13. How the machine operation is performed in self-controlled mode?

For machine operation in the self-controlled mode, rotating filed speed should be the same as rotor speed. This condition is relaised by making frequency of voltage induced in the armature. Firning pulses are therefore generated either by comparison of motor terminal voltages or by rotor position sensors.

14. What is meant by margin angle of commutation?

The difference between the lead angle of firing and the overlap angle is called the margin angle of commutation. If this angle of the thyristor, commutation failure occurs. Safe commutation is assured if this angle has a minimum value equal to the turn off angle f the thyristor.

15. What are the disadvantages of VSI fed synchronous motor drive?

VSI synchronous motor drives might impose fewer problems both on machine as well as on the system design. A normal VSI with 180° conduction of thyristors required forced commutation and load commutation is not possible.

16. How is PNM inverter supplied in VSI fed synchronous motor?

When a PWM inverter is used, two cases may arise the inverter may be fed from a constant D.C. source in which case regeneration is straight forward. The D.C. supply to the inverter may be obtained form a diode rectifier. In this case an additional phase controlled converter is required on the line side.

17. What is D.C. link converter and cycloconverter?

D.C. link converter is a two stage conversion device which provides a variable voltage, variable frequency supply.
Cycloconverter is a single stage conversion device which provides a Variable voltage, variable frequency supply.

18. What are the disadvantages of cycloconverter?

A cycloconverter requires large number of thyristors and ts control circuitry is complex. Converter grade thyristors are sufficient but the cost of the converter is high.

19. What are the applications of cycloconverter?

A cycloconverter drive is attractive for law speed operation and is frequently employed in large, low speed reversing mils requiring rapid acceleration and deceleration. Typical applications are large gearless drives, e.g. drives for reversing mills, mine heists, etc.

20. Give the application of CSI fed synchronous motor.

Application of this type of drive is in gas turbine starting pumped hydroturbine starting, pump and blower drives, etc.

23 What are the disadvantages of machine commutation?

The disadvantages of machine commutation are,

a. Limitation on the speed range. b. The machine size is large

23 Due to overexciting it is underutilized.

23 What is the use of an auxiliary motor?

Sometimes when the power is small an auxiliary motor can be used to run up the synchronous motor to the desired speed.

23. What are the advantages of brushless D.C. motor?

The brushless D.C. motor is in fact an inverter-fed self controlled permanent synchronous motor drive. The advantages of brushless D.C. motor are low cost, simplicity reliability and good performance.

24. When can the synchronous motor be load commutated?

When the synchronous motor operates at a leading power factor thyristors of load side converter can be commutated by the motor induced voltages same way as the thyristors of a line commutated converter are commutated by line voltages.

5888 What are the characteristics of self controlled mode operated synchronous motor?

5888 It operates at like dc motor also commutator less motor.

5889 These machines have better stability behavior.

5890 Do not have oscillatory behavior.

5889 **What are the characteristics of true synchronus mode operated synchronous motor?** The motor behaves like conventional synchronous motor i.e) hunting oscillations exists. The change in frequency is slow enough for rotor to truck the changes. Multi motor operation is possible here.

5890 What is meant by sub synchronous speed operation?

The sub synchronous speed operation means the SRIM speed can be controlled below the

synchronous speed. i.e) the slip power is fed back to the supply.

0 What is meant by super synchronous speed operation?

The super synchronous speed operation means the SRIM speed can be controlled above the synchronous speed. i.e) the supply is fed back to the rotor side.

PART-B

UNIT-I

Label the essential parts of electric drive. Explain its function.

(i) Discuss and Draw the speed-torque characteristics of various types of loads. (ii) Discuss in detail about the multi quadrant dynamies of electric drives.

0 Define how the following speed transitions are carried out : (i) Increase in speed in same direction. (ii) Decrease in speed in same direction. (iii) Speed reversal.

1 (i) Show a motor is coupled to a load having the following characteristics: Motor: Tm = 15 – 06 ωα Load: TL = 0.5 ω α 2 Find out the stable operating point for this condition.(ii) Explain in detail about steady state stability in electrical drive system.

23(i) Discuss in detail the multi quadrant dynamics in the speed – torque plane. (BTL2) (8)
(ii) Discuss the different modes of operation of an electrical drive.

23 (i) Explain the four quadrant operation of low speed hoist in detail. (ii) Explain and derive an equation to find out equivalent load torque in a motor load system with translational and rotational motion?

24 Compose the mathematical condition to obtain steady state stability of equilibrium point?

25 Explain in detail the multi quadrant operation of low speed hoist in speed torque plane.

26 Solve a motor drives two loads. One has rotational motion. It is coupled to the motor through a reduction gear with a = 0.1 and efficiency of 90%. The load has a moment of inertia of 10 kg-m2 and a torque of 10 N-m. Other load has translational motion and consists of 1000kg weight to be lifted up at a uniform speed of 1.5 m/s. coupling between this load and the motor has an efficiency of 85%. Motor has inertia of 0.2 kg-m2 and runs at a constant speed of 1420 rpm. Determine equivalent inertia referred to the motor shaft and power developed by the motor.10. Define in detail about the braking of DC and AC drives.

UNIT-II

PART-B

23 Explain the steady state analysis of the single phase fully controlled converter fed separately excited DC motor drive for continuous current mode. Also explain its operation in motoring and regenerative braking mode.

24 Solve a 250V separately excited dc motor has an armature resistance of 2.5Ω when driving a load at 600 r.p.m. with constant torque, the armature takes 20 A. This motor is controlled by a chopper circuit with a frequency of 400 Hz and an input voltage of 250 V. (i) What should be the value of the duty ratio if one desires to reduce the speed from 600 to 540 r.p.m. with the load

torque maintained constant? (ii) Find out the value of duty ratio for which the per unit ripple current will be maximum.

23 Describe about Electrical –mechanical characteristics of commonly used electric motors.

24 (i) Explain the operation of four quadrant dc chopper drive.(BTL4) (8) (ii) Solve a 220 V, 20 A, 1000 rpm separately excited dc motor has an armature resistance of 2.5 Ω. The motor is controlled by a step-down chopper with a frequency of 1 kHz. The input dc voltage to the chopper is 250V. Identify what will be the duty cycle of the chopper for the motor to operate at a speed of 600 rpm delivering the rated torque?

25 (i)Explain in detail the single phase fully controlled rectifier control of dc separately excited motor with heat waveforms. (ii) Solve a 220 V, 1500 rpm, 10 A separately excited DC motor has an armature resistance of . It is fed from a single phase fully controlled rectifier with a source voltage of 230 V 50 Hz. Assuming continuous load current. Compute (1) Motor speed at the firing angle of 30◦ and Torque of 5 Nm. (2) Developed Torque at the firing angle of 45◦ and speed of 1000 rpm.

26 (i) Define in detail about the regenerative operation of three phase fully controlled rectifier
control of separately excited DC motor. (ii) Define in detail about the four quadrant operation of chopper fed drive.

5888 Compose the operation of single phase controlled converter fed separately excited DC motor in continuous and discontinuous modes with neat diagram, waveforms and comment the steady state analysis?

5888 Discuss the four quadrant operation of chopper fed DC drive.

5889 Define in detail about the operation of single phase fully-controlled converter fed dc separately excited motor in continuous and discontinuous modes of operation with necessary waveforms and steady state analysis.

2304ΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□Ā□Ā□Ā뜀ǰ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□ (i) Discuss the different control techniques of chopper in detail. (ii) Discuss the four quadrant operation of DC-DC converter.

UNIT-II
PART-B

0 Discuss in detail with suitable diagrams and waveforms the v/f control applied to induction motor drives.

1 (i) Tell Why a cycloconverter fed induction motor drive is preferred over inverter controlled synchronous motor drive for low speed applications? (ii) Define in detail about the principle of vector control of induction motor drive.

2 Explain the four modes of operation of a static Scherbius drive.. (i) Describe the VSI fed induction motor drive.(ii) Explain in detail the static rotor resistance control in the induction motor 5. Explain in detail about the vector control for an induction motor. 6. (i) Describe the concept of v/f control scheme. (ii) Describe the variable frequency operation of induction motor in closed loop with constant -gap flux. 7. i) Describe the v/f control scheme of induction motor drive with a neat diagram. ii) Show and explain with a neat diagram the field weakening mode control of induction motor drives.

0 (i) Compare VSI and CSI fed induction motor drive. (ii) Show and Explain the block diagram of vector control of induction motor drive.

0 Compose in detail about the closed loop operation of armature voltage control method with field weakening mode control in detail.

1 (i) Define the VSI fed induction motor drives. (ii) Define the CSI fed induction motor drives.

UNIT-III
PART-B

23 (i)Discuss briefly separate controlled mode of synchronous motor in detail (ii)Explain self control of synchronous motor drive in detail

(i)Explain margin angle control of synchronous motor drive. (ii)Describe briefly the power factor angle control of synchronous motors with relevant vector diagram.

23 (i) Explain commutator less Dc motor. (ii)Describe closed loop speed control of load commutated inverter synchronous motor drive and explain it.

(i)Describe the open loop v/f control of VSI fed synchronous motor in detail (ii)Describe the CSI fed synchronous motor drive in detail.

Describe the closed loop operation of permanent magnet synchronous motor drive in details.

23 Discuss the construction and working of permanent magnet synchronous motor with neat diagram

23 (i)Name the various types of permanent magnet synchronous motor and explain it .
(ii)Describe the vector control of sinusoidal SPM in constant torque region.

24 A 3phase, 400V, 50Hz, 6pole star connected round rotor synchronous motor has Zs=0+j2Ω Load torque proportional to speed squared is 340Nm at rated synchronous speed. The speed of the motor is lowered by keeping v/f constant and maintaining unity pf by field control of the motor. For the motor operation at 600 rpm, calculate a) supply voltage b) armature current c) excitation angle d) load angle e) pull out torque. Neglect rotational losses.

25 A 7MW, three phase 12 kV star connected 6 pole 50Hz 0.9 leading power factor synchronous motor has Xs= 10Ω and Rs=0. The rated field current is 40A. The machine is controlled by variable frequency control at constant V/f ratio up to the base speed and at constant V above base speed. Evaluate(i) Torque (ii) The field current for the rated armature current 750rpm and 0.8 leading power factor.

23 A 500kW, 3 phase, 3.3 kV, 50 Hz, 0.8 lagging power factor, 4 pole, star connected synchronous motor has the following parameters Xs=15Ω, Rs=0.Rated field current s 10A. Calculate armature current and power factor at half the rated torque and field current .

UNIT-IV
PART-B

23 (i)Discuss briefly separate controlled mode of synchronous motor in detail (ii)Explain self control of synchronous motor drive in detail

24 (i)Explain margin angle control of synchronous motor drive. (ii)Describe briefly the power factor angle control of synchronous motors with relevant vector diagram

(i) Explain commutator less Dc motor. (ii)Describe closed loop speed control of load commutated inverter synchronous motor drive and explain it.

23 (i)Describe the open loop v/f control of VSI fed synchronous motor in detail (ii)Describe the CSI fed synchronous motor drive in detail.

24 Describe the closed loop operation of permanent magnet synchronous motor drive in details.

Discuss the construction and working of permanent magnet synchronous motor with neat diagram

(i)Name the various types of permanent magnet synchronous motor and explain it . (ii)Describe the vector control of sinusoidal SPM in constant torque region.

23 A 3phase, 400V, 50Hz, 6pole star connected round rotor synchronous motor has Zs=0+j2Ω Load torque proportional to speed squared is 340Nm at rated synchronous speed. The speed of the motor is lowered by keeping v/f constant and maintaining unity pf by field control of the motor. For the motor operation www.Vidyarthiplus.com www.Vidyarthiplus.com at 600 rpm, calculate a) supply voltage b) armature current c) excitation angle d) load angle e) pull out torque. Neglect rotational losses

A 7MW, three phase 12 kV star connected 6 pole 50Hz 0.9 leading power factor synchronous motor has Xs= 10Ω and Rs=0. The rated field current is 40A. The machine is controlled by variable frequency control at constant V/f ratio up to the base speed and at constant V above base speed. Evaluate(i) Torque (ii) The field current for the rated armature current 750rpm and 0.8 leading power factor.

A 500kW, 3 phase, 3.3 kV, 50 Hz, 0.8 lagging power factor, 4 pole, star connected synchronous motor has the following parameters Xs=15Ω, Rs=0.Rated field current s 10A. Calculate armature current and power factor at half the rated torque and field current

UNIT-V
PART-B

23 Derive and explain from basic principles the transfer function for separately excited DC motor load system with converter fed armature voltage control.

Explain the closed loop operation of armature voltage control method and field weakening mode control for Dc drive.

23 Describe the step by step procedure for the design of current controller.

Give the design procedure for speed controller of an electrical drive system with necessary diagrams

23 Discuss the use of simulation software package for design of controller for drives
List the factors involved in converter selection and equations involved in controller characteristics.

23 A 50KW, 240V, 1700 rpm separately excited DC motor is controlled by a converter. The field current is maintained at If=1.4A and the machine back EMF constant is Kv=.91VA rad/sec.The armature resistance is Rm=0.1Ω and thev is constriction constant is B=0.3Nm/rad/sec. The amplification of the speed sensor is K1=95mV/rad/sec and the gain of the power controller is K2=100. Calculate (i)The reference voltage Vr to drive the motor at the rated speed. (ii)If the reference voltage is kept unchanged, determine the speed at which the motor develops rated torque.

23 Discuss the current controller design using (i) P controller and (II) PI controller for a separately excited dc motor drive systems.

24 Design a speed controller Dc motor drive maintaining the field flux constant. The motor parameters and ratings are as follows. 220V, 8.3A, 1470 rpm, Ra = 4Ω, J = 0.0607 kg-m2, La = 5888 072H,Bt = 0.0869 Nm/rad/sec, Kb = 1.26V/rad/sec The converter is supplied from 230V, 3phase AC at 60 Hz. The converter is linear and its maximum control input voltage is ±10 V. The tacho generator has the transfer function Gw(s) =(0.065)/(1+0.002s). The speed reference voltage has a maximum of 10V. The maximum current permitted in the motor is 20A

5888 Using suitable block diagram explain the following controls. (i)Current limit control.

EMBEDDED SYSTEMS

PART-A

UNIT 1: INTRODUCTION TO EMBEDDED SYSTEMS

0 What is an embedded system?

An Embedded System is one that has computer hardware with software embedded in it as one of its important components.

0 Mention the major challenges in embedded system design. Available system memory.

Available processor speed.

The need to limit power dissipation when running the system continuously in cycles of "wait for events", "run", "wake-up" and "sleep".

The choice of hardware.

Restricted development environment.

1 List out the factors to be considered while writing embedded application programs.

The following factors to be considered while writing embedded application programs:

0 Reliability

1 Cost Effectiveness

2 Low power consumption

3 Efficient use of processing power

4 Efficient use of memory

5 Appropriate execution time

What are the main components of embedded system? An embedded system has three main components: They are

- Hardware processor: RAM, ROM, ADC, DAC, Timers, Ports, etc.
- Application software: written in assembly, c, c++, Java, etc.
- Real Time Operating Systems: µ *c* OS-II, WINCE, VxWorks, Embedded Linux, etc.,

What are various classifications of embedded system?

0 Small Scale Embedded system

1 Medium Scale Embedded system

2 Sophisticated Embedded system

0 Give examples for sophisticated embedded systems.

23 Embedded system for wireless LAN and for convergent technology devices.

24 Embedded system for real time video and speech or multimedia processing systems.

25 Security products and high speed network security.

26 Embedded sophisticated system for space lifeboat (NASA's X-38)

23 What is embedded processor? Give example.

A microcontroller or microprocessor which is specially designed with the following capabilities is called embedded processor.

23 Fast context switching

24 Atomic ALU operation

25 RISC core for fast, more precise and intensive calculation by the embedded software. **Examples:** ARM 7, AMD family 29050

5888 Define kernel.

A program with functions for memory allocation and de-allocation, task scheduling, inter-process communication, effective management of shared memory access by using the signals, exception handling signals, semaphores, queues, mailboxes, pipes and device management.

0 **Which type of memory is more suitable for embedded system? Justify your answer.**

The RAM family includes two important memory devices: static RAM (SRAM) and dynamic RAM (DRAM). The primary difference between them is the lifetime of data they store. RAM retains its contents as long as electrical power is applied to the chip. If the power is turned off or lost temporarily, its content will be lost forever, DRAM, on the other hand, an extremely short data life time-typically about four milliseconds. This is true even when the power is applied constantly.

Memories in the ROM family are distinguished by the methods used to write new data to them (usually called programming) and the number of times they can be rewritten. This classification reflects the evolution if ROM devices from hardwired to programmable to erased-and-programming. A common feature of all these devices is their ability to retain data and programs forever, even during power failure.

1 What is the real time system?

A real time is one that must process information and produce a response within a specified time, else risk sever consequences, including failure. That is, in a system with a real time constraint it is no good to have the correct action or the correct answer after a certain deadline. It is either by the deadline or its useless.

0 Write the function of one time devices programming.

A Programmable read only memory (PROM) or field programmable read only memory (FPROM) or one time programmable memory non volatile memory (OTP NVM) is a form of digital memory where the setting of each bit is locked by a fuse or antifuse. They are a type of ROM meaning the data in them is permanent and cannot be changed. Programs such as a firmware. The key difference from a standard ROM is that the data is written into a ROM during manufacture, while with a PROM the data is programmed into them after manufacture. So ROMs are used only for large production runs, while PROMs are used sor smaller productions where the program may be have to be changed.

0 What is DMA?

A direct memory access (DMA) is an operation in which data is copied (transported) from one resource to another resource in a computer system without the involvement of the CPU.

0 Name the different modes of DMA.

- Burst Mode
- Cycle Stealing Mode
- Transparent Mode

1 **Write the advantages and disadvantages of DMA.** Advantages

- Computer system performance is improved by direct transfer of data between memory and I/O devices, bypassing the CPU.
- CPU is free to perform operations that do not use system buses.

Disadvantages

- In case of Burst Mode data transfer, the CPU is rendered inactive for relatively long periods of time.

2 List the applications of DMA.

Wherever large amounts of data need to be transferred fast between memory and an I/O peripheral devices, e.g.

0 Hard disk, CD
1 Video memory to refresh display
2 Sound cards
3 Network cards
4 Data acquisition boards

Also for row address generation by hardware to refresh large DRAMs fast-No data transfer.

0 What is memory management system? Also write the types of memory management methods.

Memory management is the process of controlling and coordinating computer memory, assigning portions called blocks to various programs to optimize overall system performance. Memory management can be divided into two types. They are,

- Static memory management
- Dynamic memory management

1 What is Watchdog timer?

A watchdog timer is a hardware timing device that triggers a system reset, or similar operation, after a designated amount of time has elapsed.

0 What is an ICE?

An in-circuit emulator (ICE) is a hardware interface that allows a programmer to change or debug the software in an embedded system. The ICE is temporarily installed between the embedded system and an external terminal or personal computer so that the programmer can observe and alter what takes place in the embedded system, which has no display or keyboard of its own.

256ΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□dĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā □□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□ What are the limitations of ICE?

- Availability and Cost
- On Chip Functions
- Transparency

257ΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā□dĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□Ā □□ĀÀΓĀ□Ā□Ā□Ā□Ā□Ā□Ā□ What do you mean by debugging?

Debugging is a methodical process of finding and reducing the number of bugs, or defects, in a program.

UNIT 2: EMBEDDED NETWORKING

0 Define I/O device.

I/O device is defined as device which gets input and prints output to the people. With help of input devices, the inputs are given to the computer. Similarly with the help of output devices, the output was printed to the environment.

0 Give some examples of I/O devices.

5888 Keyboards
5889 Scanners
5890 Disk drivers
5891 Displays
5892 Printers and
5893 Tape drivers

0 Define serial port.

It is a port used for serial communication, over a given line or channel one bit can communicate and the bits which transmit at periodic intervals generated by a clock.

0 Define parallel port.

Parallel port means, multiple bits which communicate over a set of parallel lines at any given distance. A parallel port communicates within the same board, between IC's or wires over very short distances of at most less than a meter.

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- Synchronous communication
- ISO – Synchronous communication and
- Asynchronous communication

ÀĀÀÀĀ□Ā□Ā□Ā□Ā□ĀĀĀĀÀĀĀĀÈÀĀÀÀr□ÀĀÀr Ā□Ā□Ā□Ā□Ā□□ĀÀr ĀÀĀ513 List the examples of Internal serial communication devices.

Internal serial communication devices are available in most of the microcontrollers. Those microcontrollers are

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5633r Ā□Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr ĀÈĀĀĀĀ□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr ĀÈĀÀÀĀr Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr Ā□Ā□Ā□Ā□Ā□Ā□Ā□ Motorola M68HC11E2 and

5634r Ā□Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr ĀÈĀĀĀĀ□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr ĀÈĀÀÀĀr Ā□Ā□Ā□Ā□Ā□Ā□Ā□□ĀÀr Ā□Ā□Ā□Ā□Ā□Ā□Ā□ Intel 80196

0 **List the various components of synchronous serial input and output ports.** Types of serial ports

- Synchronous Serial Input
- Synchronous Serial Output
- Asynchronous Serial UART input
- Asynchronous Serial UART output

1 Define full duplex and half duplex communication.

Full duplex

A serial port having two distinct I/O lines or communication channels.

Example: A Modem connection to the computer COM port. There are two lines *Tx**D*** and *Rx**D*** at 9 pins or 25 pins connector. Message flows both ways at an instance.

Half duplex

A serial port having one common line or I/O communication channel.

Example: A walky – talky where message flows one way at an instance.

0 **Mention the advantages and disadvantages of interrupt I/O operations.** Advantages of Interrupt – driven I/O

- The CPU issues a command to the I/O module and then gets on with executing other instructions.
- The I/O module interrupts the CPU when it is ready to exchange data with the CPU.
- The CPU than executes the data transfer. Most computer have interrupt lines to detect and record the arrival of an interrupt request.

Disadvantages of Interrupt – driven I/O

- CPU is responsible for managing I/O data transfer.
- Every transferred word must go through the CPU.

- Devices with large transfer, eg., Disk drive, the CPU wastes times dealing with data transfer. Solution: Direct-memory-access (DMA).

What are the differences between half duplex and full duplex data transfer.

Sl.No.	Half duplex	Full duplex
1.	It is used to describe communication where only...one side can talk at a time.	It is used to describe communication where both sides are able to send and receive data at the same time.
2.	Once one side has finished transmitting its data, the other side can respond. Only one node can talk at a time. If both try to talk at the same time, a collision will occur on the network.	There is no danger of a collision and therefore the transfer of data is completed much faster.
3.	This method of communication is not very efficient and requires more time to send/receive larger amounts of data.	All networks make use of switches (rather than hubs) and UTP Ethernet cabling,which allowfull-duplex communication between all connected hosts.

0 Justify why embedded system design is so complex.

Design requirements

Embedded computers typically have tight constraints on both functionality and implementation. In particular, they must guarantee real time operation reactive to external events, conform to size and weight limits, budget power and cooling consumption, satisfy safety and reliability requirements and meet tight cost targets. Real time/reactive operation, small size, low weight, safe and reliable, Harsh environment, cost sensitivity, system – level requirements, controlling physical systems, power management.

1 Mention the various serial bus communication protocols.

0 RS-232 Standard
1 RS-422
2 RS-485
3 CAN (Controller Area Network) Bus
4 SPI (Serial Peripheral Interface) Bus and
5 I^2C (Inter Integrated Circuits) Bus

0 What is RS-232 Standard?

This is the original serial port interface **"standard"** and it stands for "Recommended Standard Number 232" or more appropriately EIA Recommended Standard 232 is the oldest and the most popular serial communication standard. It was introduces first in 1962 to help ensure connectivity and compatibility across manufactures for simple serial data communications.

0 Give the advantages and disadvantages of RS-232 standard. Advantages

- Data connectivity between portable handheld devices and a P.C. Such devices require RS-232IC to be very small, have low current drain, and operate from +3 V to +5 V supply.
- They provide ESD protection on all transmit and receive pins. It was specifically designed for handheld devices and support data rates greater than 250 kbps, operate down to +2.7 V.

5888 It can automatically go into a standby mode drawing very small currents of the order of 150 nA when not in use, provide 15 kV ESD protection on data pins and are in the near-chip-scale 5x5 mm quad flat no-lead package.

Disadvantage

5889 Since it is a single – ended system, it is more susceptible to induced noise, ground loops and ground shifts, a ground at one end and not the same potential as at the other end of the cable.

0 What is RS-422 (EIA Recommended Standard 422)?

It is designed, specifically; to overcome the distance and speed limitations of RS-232. Similar to the more advanced RS-232 C, but can accommodate higher band rates and longer cable lengths and accommodate multiple receivers.

23 List the applications of RS-422.

- Process control applications
- Ground voltage references can occur in electrically noise environments where heavy electrical machinery is operating.

24 What is RS-485 standard?

It is an improved RS-422 with the capability of connecting a number of devices (transceivers) on one serial bus to form a network.

23 Mention the advantages of RS-485 standard.

23 Among all of the asynchronous standards mentioned above this standard offers the maximum data rate.

24 A part from that special hardware for avoiding bus contention and,

25 A higher receiver input impedance with lower Driver load impedances are its other assets.

23 Distinguish between RS-232, RS-422 and RS-485 standards.

Electrical/Mechanical Characteristics	**RS-232**	**RS-422**	**RS-485**
Signalling Techniques	Single-Ended (Unbalanced)	Differential (Balanced)	Differential (Balanced)
Maximum cable length	50 feet	4000 feet	4000 feet
Original Standard Maximum Data Rate	20 kbps	10 Mbps down to 100 kbps	10 Mbps down to 100 kbps

23 What is CAN bus?

CAN-bus line usually interconnects to a controller between line and host at the node. It gives the input and gets output between the physical and data link layers at the host node. The CAN controller has a BIU (Bus Interface Unit consisting of buffer and driver), protocol controller, status – cum control registers, receiver – buffer and message objects. These units connect the lost node through the host interface circuit.

23 Mention the features of CAN Bus.

23 It is a standard bus in distributed network.

24 It has a serial line which is bidirectional.

23 What is recessive state?

23 What is dominant state?

A node gets the input at any instance from the line after sensing that instant when the line is pulled down to '0'. The later is called dominant state.

23 A node sends data bits at a time as the data frame.

24 It starts with '1' and always ends with seven '0'.

23 List the uses of CAN Bus.

- Automotive electronics
- Medical electronics and
- Industrial plant controllers

24 Give the definition of SPI.

SPI is a synchronous protocol which stands for Serial Peripheral Interface. It allows a master device to initiate communication with a slave device. Data is exchanged between these devices. In SPI, separate wires (signals) are required for data and clock. In the SPI format, the clock is not included in the data stream and must be furnished as a separate signal. The MC68HC11A8SPI system may be configured either as a master or as a slave.

23 Give the features of SPI.

23 Full Duplex, Three-Wire Synchronous Transfers
24 Master or slave operation
25 1.5 MHz (Maximum) Master Bit Frequency
26 3 MHz (Maximum) Slave Bit Frequency
27 Four Programmable Master Bit Rates
28 Programmable clock polarity and phase
29 End-of-Transmission Interrupt Flag
30 Write Collision Flag Protection
31 Master – Master Mode Fault Protection
32 Easily Interfaces to Simple Expansion Parts (PLLS, D/AS, Latches, Display Drivers, etc).

23 List the signals of SPI.

The four basic signals of SPI are

- MISO (Master In Slave Out)
- MOSI (Master Out Slave In)
- (Serial Clock) and

23 $\overline{SS}$ (Slave Select)

23 Mention the registers of SPI

There are three registers in SPI which provide control, status and data storage functions.

0 SPCR (Serial Peripheral Control Register)
1 SPSR (Serial Peripheral Status Register) and
2 SPDR (Serial Peripheral Data I/O Register)

What is I^2C bus?

The I^2C bus module provides an interface between the TC1648X/C6472 device and other devices complaint with the I^2C bus specification and connected by way of an I^2C bus. External components attached to this 2-wire serial bus can transmit and receive upto 8-bit wide data to and from the device through the I^2C module.

(or)

I^2C (Inter-Integrated Circuit)

I^2C is a multi-master, multi-slave, single-ended, serial computer bus invented by Philips semiconductor, known today as $N \times P$ semiconductors, used for attaching low-speed peripherals to computer mother boards and embedded systems. Alternatively I^2C is spelled *I2C*.

0 Mention the features of I^2C bus.

0 It is serial bus for interconnecting 'IC's.

1 It has a start and stop bit.

2 The inter IC or I^2C as it is more known was developed by Philips for use with television else.

3 It is simple serial interface currently used.

4 It combines both hardware and software protocols to give a bus interface.

5 The bus consists 2 lines called SDL and SCL.

6 Both bus masters and slave peripheral devices simply attack to these 2 lines.

0 **List the advantages of I^2C bus.**

Time taken by algorithm in master hardware that analyses the bits by I^2C in case slave hardware does not provide for hardware that supports it.

0 What are the various standards of I^2C bus? There are three types of bus standards namely,

- Industrial 100 kbps I^2C
- 100 kbps SM I^2C and
- 400 kbps I^2C

1 What is the need for device drivers?

Each device in a system needs device drive routines. An ISR relates to a device driver function. A device driver is a function used by a high – level language programmer and does the interaction with the device hardware and communicates data to the device, sends control commands to the device and runs the codes for reading the device data. A programmer uses generic commands for the device driver for using a device. The OS provides these generic commands.

UNIT 3: EMBEDDED FIRMWARE DEVELOPMENT ENVIRONMENT

5888 What is an embedded firmware?

Embedded firmware is the flash memory chip that stores specialized software running in a chip in an embedded device to control its functions.

0 Write the need of an EDLC.

EDLC is essential for understanding the scope and complexity of the work involved in any embedded product development. EDLC defines the interaction and activates among various groups of a product development sector including project management, system design and development and enclosure design and development system testing, release management and quality assurance.

23 List the objectives of EDLC. EDLC has three primary objectives, namely

23 Ensure that high quality products are delivered to end user.

24 Risk minimization and defect prevention in product development through project management.

25 Maximize the productivity.

23 List the different phases of EDLC.

New product development life cycle for embedded products typically involves the following important phases.

23 Need

24 Conceptualization

25 Analysis

26 Design

27 Development and Testing

28 Deployment

29 Support

30 Upgrades

31 Retirement/Disposal

23 What is modelling of EDLC?

The term modelling is the embedded product development life cycle refers to the interconnection of various phases involved in the development of the embedded product.

23 Write the objectives of product testing.

Product testing ensure the performance and reliable of the product which has been done before releasing to the customer. However, testing is more than making sure the software doesn't crash at a critical moment, although it is by no means an insignificant consideration.

23 What is complex testing?

Exercising an embedded system is generally more difficult than typing in some data. We may have to run a real machine in order to generate the proper data. The timing of data is often important, meaning that we cannot separate the testing of an embedded computer from the machine in which it is embedded.

23 What do you mean by data flow graph?

The Data Flow Graph (DFG) model translates the data processing requirements into a data flow graph. The Data Flow Graph (DFG) model is a data driven model in which the program execution is determined by data. This model emphasizes on the data and operations on the data which transforms the input data to output data.

23 What is state machine model?

The state machine is used for modelling reactive or event-driven embedded systems whose processing behaviours are dependent on state transitions. Embedded systems used in the control and industrial applications are typical examples for event driven systems. The state machine model describes the system behaviour with 'States', 'Events', 'Actions' and 'Transitions'. State is a representation of a current situation.

23 What is FSM?

A Finite State Machine (FSM) model is one in which the number of states are finite. In other words the system is described using a finite number of possible states.

23 What is ASIC?

Application Specific Integrated Circuits are a microchip designed for a special application.

23 Mention the approaches of hardware and software co-design.

23 The software development life cycle ends and the life cycle for process of integrating the software into hardware begin at the time when a system is designed.

24 Both cycles concurrently processed when co-designing a time critical sophisticated system.

23 How do you minimize the power consumption in embedded system?

In battery-powered applications, power consumption is extremely important. Even in non-battery applications, excessive consumption can increase heat dissipation. One way to make a digital system consume less power is to make it run more slowly, but naively slowing down the system can obviously lead to missed deadlines. Careful design is required to slow down the non-critical parts of the machine for power consumption while still meeting necessary performance goals.

23 What is upgradability?

The hardware platform may be used over several product generation or for several different versions of a product in the same generation, with few or no changes. However, we want to be able to add features by changing software.

23 What is hardware software co-design?

The hardware software co-design is a problem statement and while solving this problem statement in real life multiple issues will arise in the design.

23 List the fundamental issues in hardware software co-design.

- Selection of model
- Selection of architecture
- Selection of language
- Partioning system requirements into hardware and software.

24 What is computational model?

Data flow graph model, State machine model, Concurrent process model, Sequential process model, Object oriented model are the commonly used computational models in embedded system design.

23 List the commonly used architecture in system design.

- Control Architecture
- Data path Architecture
- Finite State Machine Data path Architecture
- Complex Instruction Set Computing Architecture
- Very long Instruction Word Architecture
- Parallel Processing Architecture

24 List the activities involved in the spiral model.

23 Determine objectives, alternatives, constraints.

24 Evaluate alternative, identify and resolve risks.

25 Develop and test.

26 Plan.

23 What are the tasks involved in concurrent and communication process model?

- Timer task for waiting 10 seconds (wait timer task)
- Task for checking the ignition by status (Ignition key status monitoring task)
- Task for checking the seat belt status (seat belt status monitoring task)
- Task for starting and stopping the alarm (alarm control task)

23 Alarm timer task for waiting 5 seconds (alarm timer task)

UNIT 4: RTOS BASED EMBEDDED SYSTEM DESIGN

23 Define RTOS.

Operating System with real time task scheduling, interrupt latency control, Synchronization of tasks with IPC's predictable timing and synchronization behaviour of the system.

5888 Define process.

A process is a code that has its independent program counter values and an independent stack. It is a computational unit that processes on a CPU under the control of a scheduling Kernel of an operating system.

0 Define task.

It is a computational unit or a set of codes, actions or functions that processes on a CPU under the control of a scheduling kernel of an operating system. Every task has a TCB.

0 Mention the classification of RTOS.

RTOS can be classified into three types namely,

- Hard RTOS
- Firm RTOS and
- Soft RTOS

1 List the uses of RTOS.

0 Lynx OS
1 OSE
2 QNX
3 RT linux
4 Vx Works
5 Windows CE and
6 µC/OS – II

23 What is thread?

Thread is a concept of java and unix and it is a light weight sub-process or process in a application program. It is controlled by the OS kernel. It has a process structure called thread stack at memory. It has a unique id and states.

23 What is the need for RTOS in Embedded System?

- Memory allocation de-allocation.
- Essential in multiple task function.
- Effective handling of hardware source calls.
- Effective management of the multiple states of CPU, internal and external physical or virtual devices.

24 What are the non-maskable interrupts? State how NMIs are important for embedded systems.

A Non-Maskable Interrupt (NMI) is a hardware interrupt that cannot be ignored by standard interrupt masking techniques in the system. It is typically used to signal attention for non-recoverable hardware errors.

In modern architectures, NMI are typically used to handle non-recoverable errors which need immediate attention. Therefore, such interrupts should not be masked in the normal operation of the system. These errors include non-recoverable internal system chipset errors, corruption in

system memory such as parity and ECC errors and data corruption detected on system and peripheral buses.

23 What is the use of Semaphore?

Semaphores are useful either for synchronizing execution of multiple tasks or for coordinating access to a shared resource. The following examples and general discussions illustrate using different types of semaphores to address common synchronization design requirements effectively, as listed:

23 Wait and Signal Synchronization.
24 Multiple – task Wait and signal synchronization.
25 Credit – tracking synchronization.
26 Single shared – resource access synchronization.
27 Recursive shared – resource – access synchronization and
28 Multiple shared – resource access synchronization.

What are preprocessors macros?

A preprocessor is a program that processes its input data to produce output that is used as input to another program. The output is said to be a preprocessed form of the input data, which is often used by some subsequent programs like compilers. The amount and kind of processing done depends on the nature of the preprocessor, some preprocessors are only capable of performing relatively simple textual substitutions and macro expansions, while others have the power of full-fledged programming languages.

Differentiate pre-emptive and non-emptive multitasking.

In a non-preemptive system the OS will not stop a running jobs until the job either exists or does an explicit wait.

In a preemptive system the OS can potentially stop a job midstream in its execution in order to run another job. Quite often a timer going off and the current jobs time-slice or quantum being exhausted will cause pre-emption.

Distinguish between task and process.

A program in execution is known as ‘process’. A program can have any number of processes.
Every process has its own address space.

Threads uses address spaces of the process. The difference between a thread and a process is, when the CPU switches from one process to another the current information needs to be saved in process descriptor and load the information of a new process. Switching from one thread to another is simple.

A task is simple a set of instructions loaded into the memory. Threads can themselves split into two or more simultaneously running tasks.

List out the various components of process control block.

Process Control Block (PCB also called Task Controlling Block, Task Struct or switch frame) is a data structure in the operating system kernel containing the information needed to manage a particular process. The PCB is “the manifestation of a process in an operating system”. Each process is represented in the operating system by a process control block. PCB is the data structure used by the operating system. Operating system groups all information that needs about particular process. Pointer, Process state, Program counter, CPU register, Memory management information, Accounting information.

Name some benchmarks related to RTOS.

An RTOS typically uses specialized scheduling algorithms in order to provide the real-time developer with the tools necessary to produce deterministic behaviour in the final system.
The real key is designing the scheduler. Usually, the data structure of the ready list in the scheduler is designed to minimize the worst case length of time spent in the scheduler's critical section, during which pre-emption is inhibited and in some cases, all interrupts are disabled. This benchmark measures the overhead (μ s) required to deliver a signal and switch to the high – priority process varying the particular Kernel configuration and the target architecture supported by BeRTOS.

Compare and contrast the binary semaphore and counting semaphore.

A **Binary Semaphore** is a synchronization object that can have only two states: Not taken, taken two operations are defined:

Take: Taking a binary semaphore brings it in the **"taken"** state, trying to take a semaphore that is already taken enters the invoking thread into a waiting queue.

Release: Releasing a binary semaphore brings it in the **"not taken"** state if there are not queued threads. If there are queued threads then a thread is removed from the queue and resumed, the binary semaphore remains in the **"taken"** state. Releasing a semaphore that is already in its **"not taken"** state has no effect.

A Counting Semaphore is a synchronization object that is has an arbitrarily large number of states. The internal state is defined by a signed integer variable, the counter. The counter value *N* has a precise meaning.

Negative, there are exactly – *N* threads queued on the semaphore.

Zero, no waiting threads, a wait operation would put in queue the invoking thread.

Positive, no waiting threads, a wait operation would not put in queue the invoking thread.

Two operations are defined for counting semaphores

Wait (ch SemWait () in Chibi OS/RT)

This operation decreases the semaphore counter, if the result is negative then the invoking thread is queued.

What is mailbox?

A message mailbox is an IPC queue that can be used only by a single destined task.

What is priority inversion?

A problem in which a low priority task inadvertently does not release the process for the high priority task.

What are counting semaphores?

Unsigned integers that controls the blocking or running of codes of a task as well as of an accompanying task with which it shares value.

Write the advantages of mailboxes in RTOS.

Mailboxes are much like queues. The typical RTOS has functions to create, to write to and to read from mailboxes and perhaps functions to check whether the mailbox contains any messages and to destroy the mailbox if it is no longer needed. The details of mailboxes however are different in different RTOSs.

Although some RTOSs allow a certain number of messages in each mailbox, a number that you can usually choose when you create the mailbox at a time. Once one message is written to the mailbox under these systems, the mailbox is full, no other message can be written to the mailbox until the first one is read. In some RTOSs, the number of messages in each mailbox is unlimited.

There is a limit to the total number of messages that can be in all of the mailboxes the system, but these messages will be distributed into the individual mailboxes as they are needed.

Define Semaphore (or) What is Semaphore?

It is special variable used to take note of certain actions to prevent another task or event from proceeding.

What is message pipe?

A message pipe in the strict sense is an IPC queue between two given inter-connected task or two sets of tasks.

What is priority inversion problem?

The lowest priority process is executing while highest priority process is waiting, when the lowest priority process acquires semaphore and enters into critical section which is shared and expected by higher priority process.

What is an active task in the context of VxWorks?

The active field is useful when various proposals are being presented for a project plan and ultimately one course of action will be selected. The active field is also useful when a task or a set of tasks is being cut because of a scaling back of project scope. With the active field, you can experiment with inactivating and reactivating tasks to see the resulting schedule effects.

Name some application for the VxWorks RTOS.

Engineers on ground remotely using trace **Generation, logging and debugging tools of VxWorks, determined** that the cause was unbounded priority inversion that caused real-time tasks to miss their deadlines.

As a result the exception handler reset the system each time. Although VxWorks supports priority inheritance, it was found out by using the remote debug tool to have been disabled by oversight in the configuration file. The configuration was fixed by enabling it.

Give the features of µC/OS – II.

Preemptive multitasking real-time Kernel.

Delivered with complete, clean, consistent, 100% ANSIC source code with in depth documentation.

Mutual exclusion semaphores with built in priority ceiling protocol to prevent priority inversions.

Timeouts on ‘pend’ calls to prevent deadlocks.

Up to 254 application tasks (1 task per priority level), and unlimited number of kernel objects.

Highly scalable (6k to 24k bytes code space 1k + bytes data space)

Very low interrupt disable time.

Third party certificate.

Mention features of VxWorks RTOS.

It is a product system Wind River Systems and it is host-target type real-time operating system.

The host can be either a windows or a unix machine.

VxWorks conforms to POSIX-RT.

VxWorks comes with an Integrated Development Environment (IDE) called Tornado.

In addition to the standard support for program development tools such as editor, cross-compiler, cross-debugger, etc.

Tornado contains VxSim and Wind View

VxSim simulates a VxWorks target for use as a prototyping and testing environment in the absence of the actual target board.

Wind View provides debugging tools for the simulator environment.

VxMP is the multiprocessor version of VxWorks.

Distinguish between Thread and Process.

Sl.No.	Thread	Process
1.	It is a single unit of execution and is a part of process.	It is a program execution and contains one or more threads.
2.	A thread does not have its own data memory and heap memory. It shares the data memory and heap memory with other threads of the same process.	Process has its own code memory, data memory and stack memory.
3.	A thread cannot live independently, it lives within the process.	A process contains at least one thread.
4.	There can be multiple threads in a process. The first thread (main thread) calls the main function and occupies the start of the stack memory of the process.	Threads within a process share the code, data and heap memory. Each thread holds separate memory area for stack (shares the total stack memory of the process).
5.	Threads are very inexpensive to create.	Processes are very expensive to create. Involves may OS overhead.
6.	Context switching is in expensive and fast.	Context switching is complex and involves lot of OS overhead and is comparatively slower.
7.	If a thread expires, its stack is reclaimed by the process.	If a process dies, the resources allocated to it are reclaimed by the OS and all the associated threads of the process also dies.

List the uses of VxWorks.

- Multitasking environment.

IPC

Synchronization using POSIX, event flag, mutex resource key, count.

Separate contexts for the tasks and ISRs.

Watchdog Timers

Virtual I/O Devices using pipes

Virtual memory management functions

What is Interprocess Communication?

A mechanism from one task (or process) sending signal or messages or event notification from one task to the system and which the OS communicates to another task. Using IPC mechanism and functions a task uses signals, exceptions, semaphores, queues, mailboxes, pipes, sockets and RPCS.

Define Message queue.

A task sending the multiple messages into a queue for use by another tasks using queue messages as an input.

What is meant by priority Inheritance?

low-priority task that is currently accessing a shaded resource requested by a high-priority task temporarily inherits the priority of that high-priority task, from the moment the high-priority task raises the request.

UNIT 5: EMBEDDED SYSTEM APPLICATION DEVELOPMENT

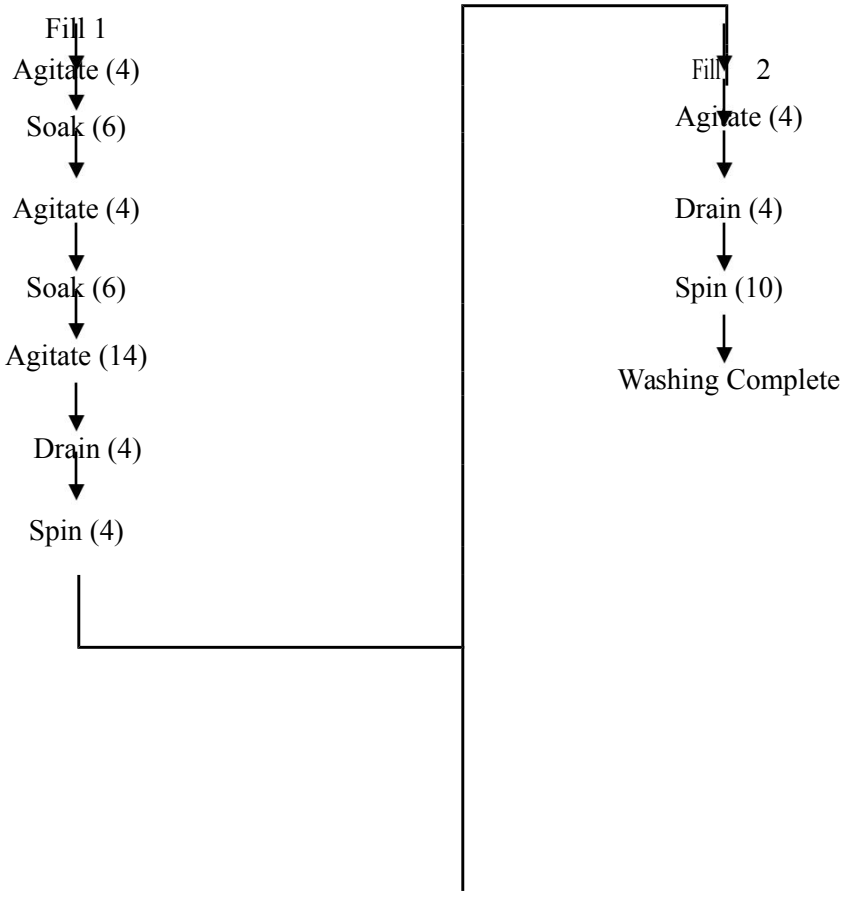
State piezo-resistive effect.

When a wire is stretched within its elastic limit, it will increase in length and correspondingly the diameter will increase. Thus, the resistance of the wire changes due to the strain. This is called piezo-resistive effect.

What are the levels made in washing machine control?

Fill
Agitate
Soak
Drain
Spin

Draw the task sequence for extra heavy program select setting in washing machine control.



4.List the control requirements in washing machine.

The following are the control requirements in washing machine.

Inter control of water

Water quantity control

Agitator control

Spin control

Drain control

5.What is meant by smart card?

It is a plastic card ISO standard dimensions 85.60×53.98×0.80 mm. The silicon chip is just a few multimeter in size and is concealed in between the layers. It is very small size protects the card from bending.

6.What are the applications of smart card?

Credit-debit bank card

ATM card

e-purse (or) e-wallet card

Identification card

Medical card (for history and diagnosis details)

7.List the embedded hardware components in smart card.

Microcontroller or ASIP

RAM for temporary variables and stack.

One time programmable ROM for application codes and RTOS codes for scheduling the tasks.Timer and Interrupt controller.

Interfacing circuit for the IOs.

Charge pump circuit.

Flash for storing user data, user address, user identification codes, card number and expiry data.

8.List the embedded software component in smart card.

Bootup, initiali and OS programs.

Smart card secure file system.

Connection establishment and termination.

Communication with host.

Cryptography algorithm.

Host authentication.

Card authentication.

9.What are the functions of Digital camera?

It displays the frame view on the LCD screen so that user can adjust the camera indication before shooting the frame.

It displays the saved images on the LCD using navigation keys.

When a key for opening the shutter is pressed, the flash lamp glows and the self-timer circuit switches off the lamp automatically.

The frame light falls on the CCD array, which transmits the bit for each pixel in each row in the frame through an ADC.

The CCD bits of each pixels in each row and column are offset corrected using a CCD signal processor (CCDSP).

10.What are the important software components used in digital camera?

- CCD signal processing for off-set correction.
- JPEG coding.
- JPEG decoding.
- Pixel processing before display.
- Memory and file system.
- Light, flash and display device drivers.

11.Define watchdog timer.

It is a timing device that resets the system after a predefined timeout. It is activated within the first few clock cycles after power up.

12.What is Data Acquisition System?

Data Acquisition System in which the computer periodically samples the value of a variable, evaluates it according to program control operations and outputs an appropriate controlling signal to the final control element.

13.What are the types of system embedded in automobile?

- Engine control
- Speed control and brake
- Safety systems
- Seat and pedal controls
- Car environment controls
- Route and traffic monitors
- Automobile status monitoring
- System interfaces for commands, voice activation and interfacing.
- Infotainment systems.

14.What is Agitator control?

During the agitate operation, the agitator moves one rotation in clockwise direction, followed by a rotation in the anticlockwise direction. This cycle is continuously repeated for the specified time. Simultaneously the basket drum undergoes 360^{o} movement, i.e. one full rotation in one minute.

15.What are the classifications of smart card?

- Contact type
- Contact lies type

16.List the requirements for building the handheld smart card reader.

- Startup task
- Battery monitoring and charge controlling task.
- Card read-write operation task
- Communication task
- Keyboard scanning task
- LCD update task
- Watching timer expire event

17.Write the functions of keyboard scanning task.

The keyboard scanning task scans the keyboard and identifies a key press and performs three operations corresponding to the key press.

EMBEDDED SYSTEM
UNIT-I
PART-B

Explain in detail about the build process for embedded systems. (16)
Describe the structural units in embedded processor. (16)
How to select the processor based upon its architecture and applications. (16)
Explain the concept of DMA. (16)
Discuss the methods in memory management. (16)
Discuss in detail about the timer and counter. (16)
Explain the classification of embedded systems with examples. (16)
Describe the working principle of in-circuit emulator. (16)
0 Illustrate the concept of watch dog timer. (16)
1 Discuss in detail about target hardware debugging. (16)

UNIT-II

Illustrate the synchronous and asynchronous communications from serial devices. (16)
2.Describe the functions of a typical parallel I/O interface with a neat diagram. (16)
Discuss the types of serial port devices. (16)
(i) Compare the advantages and disadvantages of data transfer using serial and parallel port/devices. (8)
0 Discuss the RS-232C interface standard protocol. (8)
Compare the various standards of communication protocol, UART, RS232, RS422 & RS485 (16)
(i) Demonstrate the signal using a transfer of byte when using the I2C bus and also the format of bits at the I2C bus with diagram. (8)
0 Explain CAN bus. (8)
Why we need device driver? How do you write a device driver? List the steps involved in writing a device driver. (16)
Describe SPI protocol and its interface. (16)
Justify the types and need for various bus communication standards.(16)
Describe one type of serial communication bus with its communication protocol. (16)

UNIT-III

Explain the embedded software development process. (16)
Discuss in detail about the different phases of EDLC. (16)
Generalize the various computational models in embedded design. (16)
Discuss the issues in hardware – software co-design of embedded system.(16)
Compare the various modeling of EDLC. (16)
(i) Illustrate sequential flow model with example. (16)

(ii) Illustrate Concurrent process model with example. (16)

(i) Describe object oriented model with example. (8)

0 Differences between Data flow model and state machine model. (8)

(i) Describe Data Flow Graph model with example. (8)

(ii) Describe State Machine model with example. (8)

(i) Describe in detail the Waterfall or Linear model. (8)

Describe in detail the Iterative/ Incremental or Fountain Model. (8)

10. (i) Explain in detail the Prototyping Model. (8)

Explain in detail the Spiral Model. (8)

UNIT-IV

Describe the services of UNIX based real time operating systems. Compare its features with window based real time operating systems. (16)

Discuss about the contemporary real time operating systems VxWorks, Linux and RT Linux. (16)

(i) Summarize Preemptive and Non-preemptive multitasking.(8)

(ii) Describe the three alternative systems in three RTOS for responding a hardware source call with the diagram. (8)

(i) List out the goals of operating system services. (8)

Generalize the scheduler in which RTOS insert into the list and the ready task for sequential execution in a co-operative round robin model. (8)

(i)Analyze the fifteen point strategy for synchronization between the processes, ISRs, OS functions and tasks for resource management. (8)

0 Discuss the critical section service by a preemptive scheduler. (8)

1 (i) Summarize the Rate Monotonic Co-operative scheduling. (8)

0 Explain the features of Vx Works. (8)

2 (i) List out the RTOS programming tool MicroC/OS-II (8)

0 Explain the use of semaphores for a Task or for the Critical Sections of a

Show the appropriate diagrams explain multiple tasks and multiple processes. (16)

Generalize the various scheduling policies with example. (16)

Describe the following

Context Switching (8)

UNIT-V

Design architectural hardware and software units needed in an automatic chocolate vending machine,washing machine (16)

Design architectural hardware and software units needed in smart card. (16)

Tabulate hardware units needed in each of the systems: Camera, Smart card, Automatic chocolate vending machine, Washing machine.(16)

4.Demonstrate the hardware and software units that must be present in) automatic chocolate vending machines (16)

List various types of memories and the application of each in the following systems: Robot, Digital camera, Smart card, Washing machine. (16)

Show and explain basic system of an Automatic chocolate vending system (16)

Apply suitable hardware and software to develop the embedded system for a smart card. (16)

List the various steps needed to design a smartcard (16)

Examine the components of embedded system in automatic chocolate vending machines and smartcard(16)

10.Identify the tasks for an ACVM. Explain the various interprocess communication methods required in implementing the application. (16)

POWER SYSTEM OPERATION AND CONTROL
TWO MARKS QUESTIONS AND ANSWERS

UNIT-I –INTRODUCTION

1. What is load curve?

The curve drawn between the variations of load on the power station with reference to time is known as load curve. There are three types, Daily load curve, Monthly load curve, Yearly load curve.

2. What is daily load curve?

The curve drawn between the variations of load with reference to various time period of day is known as daily load curve.

3. What is monthly load curve?

It is obtained from daily load curve. Average value of the power at a month for a different time periods are calculated and plotted in the graph which is known as monthly load curve.

4. What is yearly load curve?

It is obtained from monthly load curve which is used to find annual load factor.

5. What is connected load?

It is the sum of continuous ratings of all the equipments connected to supply systems. 6. What is Maximum demand?

It is the greatest demand of load on the power station during a given period. 7. What is Demand factor?

It is the ratio of maximum demand to connected load.

Demand factor= (max demand)/ (connected load)

8. What is Average demand?

The average of loads occurring on the power station in a given period (day or month or year) is known as average demand.

Daily average demand = (no of units generated per day)/ (24 hours)
Monthly average demand = (no of units generated in month)/ (no of hours in a month)
Yearly average demand = (no of units generated in a year)/ (no of hours in a year)

9. What is Load factor?

The ratio of average load to the maximum demand during a given period isknown as load factor.

Load factor = (average load)/ (maximum demand)

10. What is Diversity factor?

The ratio of the sum of individual maximum demand on power station is known as diversity factor.

Diversity factor = (sum of individual maximum demand)/(maximum demand).

11. What is Capacity factor?

This is the ratio of actual energy produced to the maximum possible energy that could have been produced during a given period.

Capacity factor= (actual energy produced)/ (maximum energy that have been produced)

12. What is Plant use factor?

It is the ratio of units generated to the product of plant capacity and the number of hours for which the plant was in operation.

Units generated per annum= average load * hours in a year 13. What is Load duration curve?

When the load elements of a load curve are arranged in the order of descending magnitudes the curve then obtained is called load duration curve.

14. What is the objective of power system control?

To maintain frequency and voltage for supplying electricity with proper quality.

15. What is the need for voltage regulation in power system?

In power system, voltage needs to be maintained foe supplying electricity with proper quality. The major reasons are:

All equipments and appliances are designed for a certain voltage level, the rated or name plate voltage. If the voltage V of the system should deviate from that value, the performance of the device suffers and its life expectancy drops.

The real line losses depend upon the line flow which in turn depends greatly upon line end voltages.

16. What is the need for frequency regulation in power system?

In power system, frequency needs to be maintained for supplying electricity with proper quality. The major reasons are:

Most of the AC motors run at speeds that are directly related to the frequency.

The generator turbine, particularly steam driven ones, are designed to operate at specified speed with limited tolerance in variation for maximum efficiency and less fatigue and wear and tear. The overall performance of a power system can be controlled if frequency error is kept within strict limits.

A large number of electricity operated clocks are used for power system monitoring and control. They are all driven by synchronous motors and the accuracy of these clocks is a function of the frequency error.

17. State whether changes in AVR loop will be reflected in ALFC loop.

Yes. But marginally. Any change in voltage caused by AVR loop changes the voltage – dependent load and hence the frequency, which will get reflected in the ALFC loop.

What are different types of load ? i)

Motor devices

ii) Heating element

iii) Lighting equipment

iv)A diversity of electronic gear.

How system loads are classified?

Constant power

Constant current

Constant impedance

What is the significance of load factor and diversity factor?

Load factor and Diversity factor play important roles in the cost of supply of electrical energy. Higher the values of load factor and diversity, lower will be the overall cost per unit generated. Higher the diversity factor of loads, the smaller will be the capacity of the plant requires and consequently the fixed charges due to capital investment will be much reduced.

Similarly higher load factor means more average load or more energy generated for a given maximum demand and therefore overall cost per unit of electrical energy generate d is reduced

due to distribution of standing charges(which are preoperational to maximum demand) over the number of units generated.

21. State the difference between P-f and Q-V controls.

The dependency of f and V on P and Q can be explained as follows.

A surplus of mega watts tends to increase the frequency the system. The frequency is a system – wide variable, uniform throughout of the system.Surplus of mega vars tends to increase voltage level of the system. The changes are not uniform but will be greatest at the buses where the system strength is the weakest.As we change the mega watt output of one or several generating units in order to maintain frequency constant, no resulting measurable changes occur in voltage levels.

On the contrary, as we change the Q input at a certain bus thereby affecting its voltage level (V) we do immediately also change the real voltage- dependent load of the bus. This mega watt change will have an effect on frequency.

22. Give the two major control loops of large generators.

ALFC (Automatic Load frequency Control and AVR (Automatic voltage regulation) loops.

23. What is base load?

Base load is the minimum load on a system that is fed throughout the period of system operation.

What are the two parameters that need to be maintained in a power system?

The parameters are frequency and voltage magnitude.

What happens to frequency if the load on the generator increases?

Increase in load is met from the kinetic energy of the rotating masses, because of which the speed decrease and consequently the frequency.

UNIT II REAL POWER - FREQUENCY CONTROL

State the main parts of speed governing mechanism.

Centrifugal Governor

Hydraulic amplifier

Speed changer

Linkage mechanism

Define speed regulation.

The ratio of speed deviation or frequency deviation to change in power output is known as speed regulation.

3. Define control area.

The area where all the generators are running coherently is termed as control area.

4. What do you understand by coherent group of generators?

To meet the sudden and unexpected loads the generators will be inter connected. In that area, the generators swing in unison with change in loads or due to speed changer settings. These generators are called coherent group of generators.

5. What are the functions of ALFC?

The basic role of ALFC's is to maintain desired MW output of a generator unit and assist in controlling the frequency of large interconnection. The ALFC also helps to keep the net interchange of power between pool members at predetermined values. Control should be applied in such a fashion that highly differing response characteristics of units of various types are

recognized. Also unnecessary power output changes should be kept at a minimum in order to reduce wear of control valves.

6. What is speed changer?

Speed changer makes it possible to restore the frequency to the initial value after operation of the speed governors having steady state characteristics. Further it provides a steady state power output setting for the turbines.

7. What is meant by uncontrolled case in steady state response of single area system?

If the speed changer has a fixed setting i.e.$\Delta Pc = 0$, then this case is known as controlled case.

8. What is meant by controlled case?

If the load demand remains fixed i.e, .$\Delta PD = 0$, then this case is known as controlled case.

9. Define area control error.

Area control error contains both frequency error and error in tie line power flow. (power exchange)

10. What is meant by AFRC?

Area frequency response characteristics (AFRC) is

$\beta = B+1/R$

R-speed or frequency regulation characteristics

B-load dependency constant on frequency

11. State the advantages of state variable method.

The system dynamic model in state variables is useful in designing optimal linear regulator.

State variables are amenable for computer solutions.

State variable formulation is similar for both continuous and discrete signals.

12. Specify the dis.adv of ALFC loop?

0 The ALFC loop will main control only during normal changes in load and frequency. It is typically unable to provide adequate control during emergency situations, when large MW imbalances occur.

If the system damping is not adequate, ALFC may result in hunting about the final value.

13. What are the inputs to governor?

The two inputs to governor are a) Change in reference power setting b) Change in speed / frequency.

14. What is damping factor?

Damping factor is the frequency co efficient of load and is defined as the ratio of change in load to change in frequency.

15. Specify the use of static and dynamic response of the ALFC loop.

The static response of the ALFC loop gives the steady state frequency accuracy.

The dynamic response indicates the tracking ability and stability of the loop.

Compare the functions of speed governor and speed changer in a speed governing system of a turbine- generator set.

Speed governor restricts the changes in frequency instantaneously with speed control action, but the frequency will settle at a value, which is different from rated value. Speed changer changes the quantum of fuel fuel/water input so as to bring the frequency back to the normal value. It provides a steady power output setting for the turbine. Its movement opens or closes the steam valve.

17. What is the basic principle of pool operation?

Under normal operating conditions, each pool member or control area should strive to meet its own load and such scheduled portions of the other members loads (tie line flows) as have been mutually agreed upon.

Each control area must agree upon adopting regulating and controlling strategies that are mutually beneficial under normal and abnormal situations and also for maintaining frequency and agreed tie- line flows.

18. What is the need for large mechanical forces in speed governing system? Very large mechanical forces are needed to position the main valve against the high

stream pressure and these forces are obtained via several stages of hydraulic amplifiers.

Write the tie line power deviation equation in terms of frequency.

$\Delta P_{12}=2\pi T_{12} (\int \Delta f_1 dt - \int \Delta f_2 dt)$

Where $T_{12}= V_1 * V_2 * \cos(\partial_1 - \partial_2) / X_{12}$

20. What are the advantages of pool operation with respect to LFC?

The frequency change will be only marginal compared to that would have been experienced if the areas were operating independently.

Part of added load in an area will be supplied by other areas via the tie lines.

Only the area that is responsible for change in frequency and corresponding change in tie line flows will participate in LFC.

UNIT III REACTIVE POWER–VOLTAGE CONTROL

1. What are the Methods of Voltage Control?

i. Excitation control with AVR in generating stations

ii. Tap changing transformers using in sending and receiving end of the transmission line.

iii. Shunt reactors – Low loads

iv. Shunt capacitors – high loads or low p.f load v.

Series capacitors –long EHV transmission line

0 Synchronous condenser or compensator

vii. Static VAR compensator (SVC)

What is exciter?

The fields winding of synchronous machines (alternator) are always supplied with d.c from d.c generators called exciter.

3. What are the various functions of excitation system?

Exciter is the main component in the AVR loop .The excitation system provides the agnetic field required for the synchronous machine. The AVR in the excitation system maintains/controls the terminal voltage of the synchronous generator..

What are the types of excitation system?

0 D.C Excitation system

1 A.C Excitation system

2 Static Excitation system.

What are effects of AVR loop?

0 AVR must regulate the terminal voltage V within required static accuracy limit

1 It must have sufficient speed response

2 It must be stable.

What is the necessity of stability compensation in AVR loop?

Stability compensation improves the dynamic response characteristics without affecting the static loop gain.

7. What are the power system components are generate and absorb the reactive power?

Synchronous machine under over excited condition, Shunt capacitor and cable are generating reactive power. Shunt reactor, overhead lines, transformer and Load are absorbing the reactive power.

Compare shunt and series capacitors.

0 Shunt capacitors supply capacitive reactive power to the system at the point where they are connected. Series capacitors are connected in series with the line and are used to reduce inductive reactance between supply point and load

1 It is mainly used for power factor correction at the load terminal of low voltage It is mainly used to compensate the effect of series reactance.

2 If the load VAR requirement is small, shunt capacitors are of high use. If the load VAR requirement is small, series capacitors are of small use

3 If the total line reactance is high, shunt capacitors are not effective. If the total reactance is high series capacitors are very effective and stability is improved

What is a synchronous compensator?

A Synchronous condenser is a synchronous machine running without a prime mover or a mechanical load under over excited condition. It has wide variation excitation control. It can be made to either generate or absorb reactive power.

10. Where synchronous condensers installed?

The synchronous compensator is connected to the tertiary winding of the main transformer or voltage and reactive power control at both transmission and sub transmission level. A neutral point is provided by the earthling transformer.

What are the advantages and disadvantages of synchronous compensator?

Advantages:

0 Flexibility of operation for all conditions

1 As the losses are considerable compared with static capacitors and the power factor is not zero.

Disadvantages:

2 The cost of installation is high

3 Losses of synchronous condensers are much high compared to those of capacitors.

How is voltage control obtained by using tap changing transformers?

Voltage is controlled with the help of line drop compensator, voltage sensitive regulating relay, time delay relay, etc By changing the turns ratio of transformer the voltage ratio and the secondary voltage is changed and the voltage control is obtained. So, voltage control of transmission and distribution system is obtained by tap changing.

13. What is Static VAR Compensator (SVC)? Where it is used?

SVCs are Shunt connected static generators and/or absorber whose outputs are varied so as to control specific parameters of the electric power system.The term static is used to indicate the SVC, have no moving, or rotating main components. Thus an SVC consists of static VAR generator or absorber devices and suitable devices.SVC s are located in receiving substations and distribution systems for smooth and steeples variation of compensation of reactive power injected into the line, by shunt capacitors and shunt reactors.

14. What are the different types of SVC?

The following are the basic types of reactive power control elements which make up all or part of any static VAR system.

i. Saturated reactor(SR)
0 Thyristor controlled reactor(TCR)
iii.Thyristor controlled Transformer(TCT)
1 Thyristor Switched Reactor(TSR)
2 Thyristor Switched capacitor(TSC)
0Self or line commutated converter(SCC/LCC)

Write the some applications of SVC.

0 Control of temporary (power frequency) over voltages
1 Prevention of voltage collapse
2 Enhancement of transient stability
3 Enhancement of damping of system oscillations

What are the sources of reactive power? How it is controlled? The sources of reactive power are generators, capacitors, and reactors.
These are controlled by field excitation.
The excitation system amplifiers
are, a) Magnetic amplifier
b) Rotating amplifier
c) Modern electronic amplifier
State the devices which are used for voltage control.
Source or sinks of reactive power such as shunt capacitor, shunt reactor, synchronous condensers and SVC.
Line reactance compensators
iii)Regulating transformers
State the locations to use series capacitors. i)
Midpoint of the line
ii) line terminals
iii) 1/3 or 1/4 points of the line
How are the two types of tap changing transformers used?
The off load tap changing transformer are used when the tap settings are required to be adjusted seasonally or rarely. The on- load tap changing transformer are used when the tap settings are required to be changed frequently because it is undesirable to de energize the transformers to change a tap.
20. List the various components in an AVR loop.
The various components in AVR loop are terminal voltage sensor, rectifier, filter, comparator and stabilizing network, if needed.
21.What is the disadvantage of high loop gain?
High loop gain is required for static accuracy, but this causes undesirable dynamic response and even instability at times. By adding series and or feedback stability compensation in the AVR loop , this conflicting situation can be resolved.
What is the use of off load tap changer and TCUL ?

The off- load tap changers are used when it is expected that the ratio will need to be changed only infrequently, because of load growth or some seasonal change. TCUL is used when changes

in ratio may be frequent or when it is undesirably to de-energize the transformer to change the tap.

Give two kinds of capacitors used in shunt compensator? The

two kinds of capacitors used in shunt compensator are,

a. Static Capacitor b) Switched Shunt Capacitor(Mechanically switched and Thyristor switched).

What is tap changing transformers?

All power transformers and many distribution transformers have taps in one or more windings for changing the turn's ratio. It is called tap changing transformers.

Write the types of tape changing transformers.

0 Off- load tap changing transformers.

1 Tap changing under load transformers

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH

1. Define economic dispatch problem.

The objective of economic dispatch problem is to minimize the operating cost of active power generation.

2. Define incremental cost.

The rate of change of fuel cost with active power generation is called incremental cost.

Write the load balance equation? Pg-pd-pl=0.

3. Define base point.

The present operating point of the system is called base point.

4. Define participation factor?

The change in generation required to meet power demand is called as participation factor.

5. Define hydrothermal scheduling problem.

The objective is to minimize the thermal generation cost with the constraints of water availability.

6. Define Unit commitment.

Commitment of minimum generator to meet the required demand.

7. Define spinning reserve.

It is the term describe the total amount of generation availability from all units synchronized on the system.

8. What is meant by scheduled reserve?

These include quick start diesel turbine units as well as most hydro units and pumped storage hydro units that can be brought online, synchronized and brought up to full capacity quickly.

9. What are the thermal unit constraints?

Minimum up time, minimum down time and crew constraints.

10. Define minimum up time.

Once the unit is running, it should not be turned off immediately.

11. Define min.down time.

Once the unit is decommited, there is a minimum time before it can be recommended.

12. Define crew constraints.

If a plant consist of two (or) more units, all the units cannot be turned on at the same time since there are not enough crew members to attend both units while starting up.

What are the two approaches to treat a thermal unit to operating temperature? The first allow the unit boiler to cool down and then heat backup to operating temperature in time for a scheduled turn on. The second requires that sufficient energy be input to the boiler to just maintain operating temperature.

What are the techniques for the solution of the unit commitment problem?

Priority list method, dynamic programming Lagrange relation

What are the assumptions made in dynamic programming problem?

0 Total number of units available, their individual cost characteristic and the load cycle on the stations are assumed priori (previously).

1 A state consists of an array of units with specified units operating and the rest off-line.

2 The Start-up cost of a unit is independent of the time it has been off-line (i.e., fixed amount)

3 There are no costs for shutting down a unit.

4 There is a strict priority order and in each interval a specified minimum amount of capacity must be operating

Define long range hydro scheduling problem.

The problem involves the long range of water availability and scheduling of reservoir water releases. For an interval of time that depends on the reservoir capacities.

17. What are the optimization technique for long range hydro scheduling problem?

Dynamic programming composite hydraulic simulation methods statistical production cost.

18. Define short range hydro scheduling problem.

It involves the hour by hour scheduling of all generators on a system to achieve minimum production condition for the given time period.

19. Define system blackout problem.

If any event occurs on a system that leaves it operating with limits violated, the event may be followed by a series of further actions that switch other equipment out of service. If the process of cascading failures continues, the entire system of it may completely collapse. This is referred as system blackout.

20. What is meant by cascading outages?

If one of the remaining lines is now too heavily loaded, it may open due to relay action, thereby causing even more load on the remaining lines. This type of process is often termed as cascading outage.

21. What are the advantages of using forward dynamic programming method?

Reduction in the dimensionality of the problem. i.e., number of combinations to be tried is reduced in number.

If a strict priority is imposed, the number of combinations for a 4 unit case is:

Priority 1 unit

Priority 1 unit + Priority 2 unit

Priority 1 unit + Priority 2 unit + Priority 3 unit

Priority 1 unit + Priority 2 unit + Priority 3 unit + Priority 4 unit.

22. Define must run constraint.

Some units are given a must run status during certain times of the year for reason of voltage support on the transmission network.

23. What are the assumptions made in priority list method?

No load cost are zero unit input-output characteristics are linear between zero output

and full load there are no other restrictions startup cost are affixed amount.

25. State the dis.adv of dynamic programming method.

It has the necessity of forcing the dynamic programming solution to search over a small number of commitment states to reduce the number of combinations that must be tested in each period.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS

What are the functions of control center?

System monitoring contingency analysis security constrained optimal power flow.

What is the function of system monitoring?

System monitoring provides upto date information about the power system.

Define SCADA system.

It stands for supervisory control and data acquisition system, allows a few operators to monitor the generation and high voltage transmission systems and to take action to correct overloads.

What are the states of power system?

Normal state, alert state, emergency, extremis and restorative states.

Define normal mode and alert mode..

The system is in secure even the occurrence of all possible outages has been simulated the system remain secure is called normal mode.

The occurrence of all possible outages the system does not remain in the secure is called alert mode.

What are the distribution factors?

Line outage distribution factor, generation outage distribution factor.

Define state estimation.

State estimation is the process of assigning a value to an unknown system state variable based on measurements from that system according to some criteria.

8. Define maximum likelihood criterion.

The objective is to maximize the probability that estimate the state variable x, is the true value of the state variable vector (i.e, to maximize the P(x)=x).

9. Define weighted least squares criterion.

The objective is to minimize the sum of the squares of the weighted deviations of the estimated measurements z, from the actual measurement.

10. Define minimum variance criterion.

The objective is to minimize the expected value of the squares of the deviations of the estimated components of the state variable vector from the corresponding components of the true state variable vector.

What are the known values in short term hydro scheduling problem? The

load, hydraulic inflows & unit availabilities are assumed known.

What is meant by telemetry system?

The states of the system were measured and transmitted to a control center by means of telemetry system.

13. What are the functions of security constraints optimal power flow?

In this function, contingency analysis is combined with an optimal power flow which seeks

to make changes to the optimal dispatch of generation. As well as other adjustments, so that when a security analysis is run, no contingency result in violations.

Define the state of optimal dispatch.

This is the state that the power system is in prior to any contingency. It is optimal with respect to economic operation but may not be secure.

15. Define post contingency and secure dispatch.

Post contingency is the state of the power system after a contingency has occurred and secure dispatch is state of the power system with no contingency outages, but with correction to the operating parameters to account for security violations.

16. What are the priorities for operation of modern power system?

Operate the system in such a way that power is delivered reliably. Within the constraints placed on the system operation by reliability considerations, the system will be operated most economically.

17. What is meant by linear sensitivity factor?

Many outages become very difficult to solve if it is desired to present the results quickly. Easiest way to provide quick calculation of possible overloads is linear sensitivity factors.

What are linear sensitivity factors?

Generation shift factors line outage distribution factors.

What is the use of line distribution factor?

It is used to apply to the testing for overloads when transmission circuits are lost.

What is meant by external equvalencing?

In order to simplify the calculations and memory storage the system is sub divided into 3 sub systems called as external equvalencing.

What are the functions of SCADA? a)
Monitoring
b) Alarm
c) Control data logging
d) Data acquisition
e) Control On/Off, Raise / lower
f) Display.

What are the major functions that are carried out in an operations control centre?
Short , medium and long term forecasting(LP)
System planning
Unit commitment and maintenance scheduling
Security monitoring
State estimation
Economic dispatch
Load frequency control

PART-B

UNIT I INTRODUCTION

1. A generating station has the following daily load cycle.

Time (Hours)	0-6	6-10	10-12	12-16	16-20	20-24
Load (MW)	20	25	30	25	35	20

Draw the load curve and find:

i) Maximum demand ii) Units generated per day

iii) Average load iv) Load factor.

A generating station has a maximum demand of 25 MW. Load factor is 60%, plant capacity factor is 50% and plant use factor is 72%. Find the reserve capacity, daily energy produced and maximum energy that can be produced by the plant.

The maximum demand on a power station is 100 MW. If the annual load factor is 40%, calculate the total energy generated in a year.

Write short notes on system load variation and effects of variable load.

Discuss the various reserve requirements in power system operation.

Write short notes on load forecasting and load scheduling.

A generating station has the following daily loads.

0-6 hr	- 4500 KW
6-8 hr	- 3500 KW
8-12 hr	- 7500 KW
12-14 hr	- 2000 KW
14-18 hr	- 8000 KW
18-20 hr	- 2500 KW
20-24 hr	- 5000 KW

Draw the load curve and load duration curve and determine the Load factor and plant capacity factor if the capacity of the plant is 12 MW.

A diesel station supplies the following loads to various consumers:

Industrial load – 1000 KW

Commercial load – 750 KW

Domestic load – 500 KW

Domestic light – 500 KW

If the maximum demand on the station is 2500 KW and the number of kwhr generated per year is 45×10^5, determine the diversity factor and annual load factor.

Define diversity factor. Discuss the practical ways to improve the diversity factor.

Write short notes on power system control.

A power station has to meet the following demand.

Group A: 200KW between 8 A.M. and 6 P.M.

Group B: 100KW between 6 A.M. and 10 A.M.

Group B: 50KW between 6 A.M. and 10 A.M.

Group B: 100KW between 10 A.M. and 6 P.M. and then between 6 P.M. and 6 A.M.

Plot the daily Load curve and determine diversity factor, units generated per day and load factor

UNIT II REAL POWER - FREQUENCY CONTROL

What are the components of speed governor system of an alternator? Derive its transfer function with an aid of a block diagram.

The turbo-alternators are rated at 25 MW each. They are running in parallel. The speed-load characteristics of the driving turbines are such that the frequency of alternator 1 drops uniformly

from 50 Hz on no load to 48 Hz on full load, and that of alternator 2 from 50 Hz to 48.5 Hz. How will the two machines share a load of 30 MW and find the bus-far frequency at this load? (b) Compute the maximum load that these two units can deliver without overloading either of them.

3. Derive the transfer function model and draw the block diagram for a single control area provided with governor system. From the transfer function derive the expression for steady state frequency error for a step load change.

4. Draw the transfer function block diagram for a two area system provided with governor control and obtain the steady state frequency error following a step load change in both the areas.

5. Two generators rated 400MW and 700 MW are operating in parallel. The droop characteristics of their governors are 3% and 4% respectively from no-load to full-load. Assuming that the governors are operating at 50 Hz at no load, how would a load of 1000 MW be shared between them? What will be system frequency at this load? Assume linear governor operation. Determine the full load speed for each machine.

6. Develop the state variable model of a two area system and state the advantages of the model.

7. Derive the transfer function of an uncontrolled load frequency control of a single area system

8. An isolated power system has the following parameters:

Turbine rated output=300MW.nominal frequency=50HZ.

Governor speed regulation =0.05p.u.

Inertia constant=5 Turbine time constant=0.5 sec. governor time constant.=60MW.load change=60MW. The load varies by 0.8 percent for a 1 percent in frequency. Determine the steady state frequency deviation in Hz.

A two area system connected by a tie-line has the following parameters with base MVA for each area.

Area	1	2
Turbine out put power	4000	2000
Nomial frequency	50	50
Ineria constant	4%	5%
Power system gain(kp)	50	125
Governor time constant	0.2	0.1
Turbine time constant	0.3	0.25

A load change of 80 MW occurs in area 1. Determine the steady state frequency and the change in the tie –line flow, comment on the results.

Draw the transfer function of block diagram of LFC for single area power system. provided with integral controller and explain the dynamic response for various values of gain K_1 of the integral controller.

Explain the tie –line bias control of two area system.

Derive the transfer function of an uncontrolled load frequency control of a single area system

UNIT III REACTIVE POWER–VOLTAGE CONTROL

Draw the circuit diagram for a typical excitation system and derive the transfer function model and draw the block diagram. Discuss the stability aspects of the AVR.

A three-phase overhead line has resistance and reactance of 5 and 20 ohms, respectively. The load at the receiving end is 30 MW, 0.85 power factor lagging at 33 KV. Find the voltage at the sending end. What will be the KVAR rating of the compensating equipment inserted at the receiving end so as to maintain a voltage of 33 KV at each end? Find also the maximum load that can be transmitted.

Draw the diagram of a typical automatic voltage regulator and develop its block diagram representation.

A 132 KV line is fed through an 11/132 KV transformer from a constant 11 KV supply. At the load end of the line the voltage is reduced by another transformer of nominal ratio 132/11 KV. The total impedance of the line and transformer at 132 KV is 25 + j66 ohms. Both transformers are equipped with tap changing facilities which are changed so that the product of the two off-nominal settings is unity. If load on the system is 100 MW at 0.9 pf lagging. Calculate the settings of the tap changes required to maintain the voltage of the load bus bar at 11 KV. Use base MVA of 100 MVA.

Explain how the OLTC can be used for voltage control.

Explain the injection of reactive power by switched capacitors to maintain acceptable voltage profile and to minimize transmission loss in a power system

Explain the operation of static VAR compensator and state its advantages over other methods of voltage control.

Derive the relations between voltage, power and reactive power at a node for applications in power system control.

The load at the receiving end of the three phase, overhead line is 25 MW, 0.8 lgging PF, at a line voltage of A synchronous compensator is situated at the receiving end the voltage at the both ends of the line is maintained at 33 kV. Calculate the MVAR of the compensator. The line has 5 ohms resistance per phase and 20 ohm inductive reactance per phase .

Describe about the various methods of voltage control.

UNIT IV UNIT COMMITMENT AND ECONOMIC DISPATCH

What is unit commitment problem? Discuss the constraints that are to be accounted in unit commitment problem.

Explain the priority ordering method of committing units. State merits and limitations of this method.

Develop an iterative algorithm for solving the optimum dispatch equation of an ‘n’ bus power system taking into account the effects of system losses.

A Power plant has three units with the following cost characteristics:

Where P_{Gi} ‘s are in MW. Maximum and minimum loading allowable on each unit are: 150 MW and 40 MW. Find the optimal scheduling for a load of 275 MW.

With the help of a flow chart explain forward dynamic programming solution method of unit commitment problem.

Derive coordination equation for economic dispatch without loss. Also give steps for economic dispatch calculation neglecting losses.

Determine the economic generation schedules of three generating units in a power system to meet the system load of 925 MW. The operating limit and cost function is given below:
Operating limits 250 MW ≤ PG1 ≤ 450 MW
MW ≤ PG1 ≤ 350 MW
MW ≤ PG1 ≤ 225 MW
Cost function is $F1(P_{G1}) = 0.0045 P^2_{G1} + 5.2 P_{G1} +$
$580\ F2(P_{G2}) = 0.0056 P^2_{G2} + 4.5 P_{G2} + 640$
$F3(P_{G3}) = 0.0079 P^2_{G3} + 5.8 P_{G3} + 820$

8. For a two unit system, the loss coefficients are $B_{mn} = \begin{bmatrix} 0.001 & -0.0005 \\ -0.0005 & 0.0024 \end{bmatrix}$
Incremental cost of the two units are given by
$dC1/dP_{G1} = 0.08\ P_{G1} + 16$
$dC1/dP_{G2} = 0.08\ P_{G2} + 12$
Find the optimal generations P_{G1} and P_{G2} for $\lambda=20$. Also compute the transmission loss and received power.
There are three thermal generating units which can be committed to take the system load. The fuel cost data and generation operating unit data are given below:
$F1 = 392.7 + 5.544\ P1 + 0.001093\ P1^2$
$F2 = 217 + 5.495\ P2 + 0.001358\ P2^2$
$F3 = 65.5 + 6.695\ P3 + 0.004049\ P3^2$ P1, P2, P3in MW
Generation limits: 150≤P1≤600 MW
100≤P2≤400 MW
50≤P3≤200 MW
There are no other constraints on system operation. Obtain an optimum unit commitment table. Adopt Brute force enumeration technique. Show the details of economic schedule and the component and total costs of operation for each feasible combination of units for the load level of 900 MW.
Obtain the priority list of unit commitment using full load average production cost for the given data for the load level of 900 MW.
$F1 = 392.7 + 5.544\ P1 + 0.001093\ P1^2$
$F2 = 217 + 5.495\ P2 + 0.001358\ P2^2$
$F3 = 65.5 + 6.695\ P3 + 0.004049\ P3^2$ P1, P2, P3in MW
Generation limits : 150≤P1≤600 MW
100≤P2≤400 MW
50≤P3≤200 MW
There are no other constraints on system operation. Obtain an optimum unit commitment table.

UNIT V COMPUTER CONTROL OF POWER SYSTEMS

What is EMS? What are its major functions in power system operation& control?
Draw a block diagram to show the hardware components of a SCADA system for a power system and explain the application of SCADA in monitoring and control of power system.
Write briefly about security analysis and control and its control functions.

Draw and explain the various operating states and the associated control actions of a state transition diagram.
Draw and explain the state transition diagram showing various state transition and control strategies.
Illustrate SCADA with a typical schematic.
Explain the security monitoring using state estimation with necessary diagram.
Briefly discuss the various functions of energy control centre.
Explain briefly how the system states are continuously monitored and controlled.
Write short note s on Energy management system and state estimation

DESIGN OF ELECTRICAL MACHINES

UNIT – I

INTRODUCTION

What are the considerations to be made while designing a electrical machines?
Cost
Durability
Compliance with the performance specification and consumer requirement

List some limitation of the design
Magnetic Saturation
Temperature rise
Efficiency
Standard specifications

3. Define total magnetic loading.
The total magnetic load is defined as the total flux around the armature periphery and is given by pϕ Weber's

4. Define total electric loading
The total armature ampere conductors around the armature periphery is known as the total electric loading and is given by IzZ

5. Define specific magnetic loading
The specific magnetic loading is defined as the total flux per unit area over the surface of the armature periphery and is denoted by Bav also known as average flux density.

6. Define specific electric loading
It is defined as the number of armature conductors per meter of armature periphery at the air gap.
Specific electric loading = total number ampere conductors/armature periphery at air gap.

What are the factors that decide the choice of specific magnetic loading?
Maximum flux density in iron parts of machine
Magnetizing current
Core losses

What is the factors that decide the choice of specific electric loading.
Permissible temperature rise
Voltage rating of machine
Size of machine
Current density.

How the design problems of electrical machines can be classified?
Electromagnetic design
Mechanical design
Thermal Design
Dielectric design

State the properties which determine the suitability of material for insulating materials. i) High dielectric strength
ii) Low dielectric loss
iii) Good heat conductivity

Write short notes on standard specifications.

The standard specifications are the specifications issued by the standards organization of a country. The standard specification serves as guidelines for the manufacturers to produce quality products at economical prices. The standard specifications for the electrical machines include Ratings, Types of Enclosure, Dimensions of the conductors, Name plate details, performance indices, permissible temperature rise, permissible loss, efficiency etc.,

12. What are the constituents of magnetic circuit in rotating machine?

The various elements in the flux path of the rotating machine are poles, pole shoe, air gap, rotor teeth and rotor core.

13. Write ant two similarities between magnetic and electric circuits.

In electric circuit the emf circulates current in a closed path. Similarly in a magnetic circuit the mmf creates the flux in a closed path.
In electric circuit the flow of current is opposed by resistance of the circuit. Similarly in magnetic circuit the creation of flux is opposed by reluctance of the circuit.

14. Write any two essential differences between magnetic and electric circuit.

When the current flows in electric circuit the energy is spent continuously, whereas in magnetic circuit the energy in needed only to create the flux but not to maintain it.
Current actually flows in the circuit, whereas the flux does not flow in a magnetic circuit but is only assumed to flow.

15. Classify the electrical engineering materials.

The electrical engineering materials are classified as follows:
Electrical conducting materials
Magnetic materials
Insulating materials.

16. Define specific permeance of a slot.

Specific permeance of a slot is defined as the paermeance per unit length of slot or depth of field.

17. What is unbalanced magnetic pull?

The unbalanced magnetic pull is the radial force acting on the rotor due to non uniform air gap around the armature periphery.

18. What do you understand by slot pitch?

The slot pitch is defined as the distance between centres of two adjacent slots measured in linear scale.

19. Define slot space factor or slot insulation factor.
The slot space factor is defined as the ratio of conductor area to slot area.

List the types of magnetic material. The
types of magnetic materials are: i) Soft
magnetic materials
ii) Hard magnetic materials
Define rating.
Rating of a motor is the power output or the designated operating power limit based upon certain definite conditions assigned to it by the manufacturer.
Define continuous rating.
The continuous rating of a motor is defined as the load that may be carried by the machine for an indefinite time without the temperature rise of any part exceeding the maximum permissible value.
Define short time rating.
It may be defined as its output at which it may be operated for acertain specified time without exceeding the maximum permissible vlaue of temperature rise.

What is the relation between the power developed in armature and the power output in the dc machine?
Output for generators = Pa =
P/η Output for motors = Pa = P

Write the expression for the power developed an the armature of dc machine in terms of the maximum gap density.
Power developed the armature Pa =
C0D2Lns C0 = π^{2} Bav ac x 10^{-3}

What is the range of specific magnetic loading in a dc machine?
The usual range of specific magnetic loading in dc machine is 0.4 to 0.8 wb/m2

What are the factors to be considered for the choice of specific magnetic loading?
Flux density in the teeth
Frequency of flux reversals
Size of the machine

What is the range of specific electric loading in dc machine?
The usual range of specific electric loading in dc machine is 15000 to 50000 amp.cond/m

What are the factors to be considered for the choice of specific electric loading?

0 Temperature rise
1 Speed of the machine
2 Size of the machine
3 voltage

4 Armature reaction
5 Commutation

What is the purpose of constructing the pole body by laminated sheets?
The laminated pole offers the homogeneous construction, (Because while casting internal blow holes may develop and while forging internal cracks may develop) Also the laminated poles offers the flexibility of increasing the length by keeping the diameter fixed, in order to increase the power output (or capacity) of the machine.

What are the factors to be considered for the selection of number of poles in dc machine?
Frequency
Weight of iron parts
Weight of copper parts
Length of commutator
Labour charges
Flash over and distorsion of filed form.

List the advantages of large number of poles

Weight of armature core and yoke
Cost of armature and field conductors
Overall length and diameter
Length of Commutator
Distortion of field form under load condition

10. List the disadvantages of large number of poles
The large number of poles results in increase of the following
Frequency of flux reversals
Labour charges
Possibility of lash over between brush arms.

11. Why square pole is preferred?
If the cross section of the pole body is square then the length of the mean turn of field winding is minimum. Hence to reduce the copper requirement a square cross section is preferred for the poles of the dc machines.

12. What is square pole and square pole face?
In square pole, the width of the pole body is made equal to the length of the armature. In square pole face, the pole arc is made equal to the length of the armature.

Mention guiding factors for the selection of number of poles
The frequency of flux reversals should lie between 25 to 50 Hz.
The value of current per parallel path is limited to 200 A. thus the current per brush arm should not be more than 400A

The armature mmf should not be too large. The mmf per pole should be in the range 5000 to 12500 AT.
Choose the largest value of poles which satisfies the above three conditions.

14. What are the advantages of large length of air gap in dc machine?

In dc machines a larger value of air gap length results in lesser noise, better cooling, reduced pole face losses, reduced circulating currents, less distortion of field form and lesser armature reaction.

15. What are the factors to be considered for estimating the length of air gap in dc machine?

The factors to be considered for estimating the length of air gap are armature reaction, cooling, iron losses, distortion of filed form and noise.

Mention the factors governing the choice of number of armature slots in a dc machine.
The factors governing the choice of number of armature slots are,
Slot pitch
Slot loading
Flux pulsations
Commutation
Suitability for winding

What is the purpose of slot insulation?

The conductors are placed on the slots in the armature. When the armature rotates the insulation the insulation of the conductors may damage due to vibrations. This may lead to a short circuit with armature core if the slots are not insulated.

What are the factors to be considered for deciding the slot dimensions?
Flux density in the tooth
Flux pulsations
Eddy current loss in conductors
Reactance voltage
Fabrication difficulties

What factor decides the minimum number of armature coils?

The maximum voltage between adjacent commutator segments decides the minimum number of coils.
Mention the two types of winding used in the dc machines.
Lap winding
Wave winding

What is meant by equalizer connections?

In lap winding, due to the difference in the induced emf in various parallel paths, there may be circulating currents in brushes and winding. The connections that are made to equalize the difference in induced emf and to avoid circulating currents through brushes are called equalizer connections.

What is the length of mean turn of filed coil?
Length of mean turn Lmt = 2(L p + b p + 2d r)

Mention the factors to be considered for the design of shunt field coil?
MMF per pole and flux density
Loss dissipated from the surface of field coil
Resistance of the field coil
Current density in the field conductors

Define copper space factor of the coil.

The copper space factor of a coil is defined as the ratio of conductor area and the area of the cross section of the coil.
Copper space factor = Conductor area/Area of cross section of the coil
Conductor area = Number of turns x area of cross section of conductor

25. How the ampere turns of the series field coil is estimated?

In compound machines the ampere turns to be developed by the series field coil is estimated as 15 to 25% of full load armature mmf.

In series machines the ampere turns to be developed by the series field is estimated as 1.15 to 1.25 times the full load armature mmf.

26. What is meant by commutation?
The process of current reversal in a coil is called commutation.

27. Discuss the parameters governing the length of commutator.
The length of the commutator depends upon the number of brushes and cleanliness between the brushes. The surface area required to dissipate the heat generated by the commutator losses is provided by keeping sufficient length of the commutator,

What are the factors that influence the choice of commutator diameter?
The peripheral speed
The peripheral voltage gradient should be limited to 3 V/mm
Number of coils in the armature.

What is the purpose of mica strip between two adjacent commutator segments?
Mica is placed in between two commutator segments in order to insulate the segments from each other.

What are the factors to be considered for the design of commutator?
Peripheral speed
Voltage between adjacent segments
Number of coils in the armature
The number of brushes
Commutator losses.

31. What type of copper is used for commutator segments?
The commutator segments are made of hard drawn copper or silver copper (0.05% silver)

32. What is the need for brushes in dc machine?
The brushes are used in dc machines to collect or draw current from the rotating armature.

What are the materials used for brushes in dc machines?
Natural graphite
Electro graphite
Hard carbon
Metal graphite
What is a magnetic circuit?

The magnetic circuit is the path of magnetic flux. The mmf of the circuit creates flux in the path against the reluctance of the path. The equation which relates flux mmf and the reluctance is given by,

Flux = mmf/reluctance

What is magnetization curve?

The curve shows the relation between the magnetic field intensity (H) and the flux density (B) of a magnetic material. It is used to estimate the mmf required for the flux path in the magnetic material and it is supplied by the manufacturer of stampings or laminations

35. What is meant by magnetic circuit calculations?

The calculations of reluctance, flux density and mmf for various sections of magnetic circuit are commonly referred as magnetic circuit calculations.

36. How the mmf of a magnetic circuit is determined?
`The magnetic circuit split into convenient parts (Sections) which may be connected in series or parallel. Then the reluctance, flux density and mmf for every section of the magnetic circuit is estimated. The summation of mmf of all sections in series gives the total mmf for the magnetic circuit.

37. Define gap contraction factor for the slots.

The gap contraction factor for slots Kgs is defined as the ratio of reluctance of air gap in machine with slotted armature to the reluctance of air gap in machines with smooth armature.

20. Define gap contraction factor for the ducts.
The gap contraction factor for the ducts Kgd is defined as the ratio of reluctance of air gap in machines with ducts to reluctance of air gap in machine without ducts.

38. Define total gap contraction factor, Kg.

The total gap contraction factor Kg, is defined as the ratio of reluctance of air gap of machines with slotted armature & ducts to the reluctance of air gap in machines with smooth armature and without ducts. The total gap contraction factor is equal to the product of gap contraction factors for slots and ducts.

What is carter's coefficient?

The carter's coefficient is a parameter that can be used to estimate the contracted or effective slot pitch in case of armature with open or semi enclosed slots. It is the function of the ratio w0/lg where w0 is slot opening and lg is air gap length.

Write the expression for the gap contraction factor for slots and ducts
Gap contraction factor for slots, Kgs = ys / (ys - KcsWs)
Gap contraction factor for ducts , Kgd = L / (L – Kcdndwd)

Write down the formula for computing the mmf for the air gap length.
Mmf for the air gap = 800000BgKglg in AT

Write the expressions for reluctance of air gap in machines with smooth armature and slotted armature.

Reluctance of air gap in machines with smooth armature and without ducts= lg / μ0Lys

Reluctance of air gap in machines with open armature slots and ducts= lg / μ0L'ys'

Define field form factor.
The filed form factor Kf is defined as the ratio of average gap density over the pole pitch to maximum flux density in the air gap. Kf = Bav / Bg Kf ≈ ψ = pole arc/pole pitch

List the methods used for estimating the mmf for the teeth(tapered teeth)
Graphical method
Three ordinate method (Simpson's rule)
Bt1/3 method

What is real flux density and apparent flux density?

The real flux density is due to actual flux through a tooth. The apparent flux density is due to total flux that has to be passed through the tooth. Since some of the flux passes through slot, the real flux density is always less than the apparent flux density

46. Define real flux density.
The real flux density is defined as the ratio of actual flux in the teeth to the area of the teeth

47. Define apparent flux density
The apparent flux density is defined as the ratio of the total flux in the slot pitch to the area of the teeth.
State the relation between real and apparent flux density.
Breal = Bapp - μ0**at**real(Ks – 1)

Define leakage coefficient
The leakage coefficient is defined as the ratio of total flux to the useful flux.

50. What is fringing flux?

The bulging of magnetic path at the air gap is called fringing. The fluxes in the bulged portion are called fringing flux.

UNIT – III
TRANSFORMERS

What are the various types of Transformers?
Based on construction
Core Type
Shell Type

Distribution transformer
Power transformer
Special transformers
Instrument transformer
Electronics Transformers

2. What is the range of efficiency of transformers?
The efficiency of the transformer will be in the range of 94% to 99%. Among the available electrical machines the transformer has the highest efficiency

3. What is transformer bank?
A transformer bank consists of three independent single phase transformers with their primary and secondary windings connected either in star or delta.
4. What are the salient features of distribution transformer?
The distribution transformer will have low iron loss and higher value of copper loss
The capacity of transformers will be up to 500 KVA
The transformers will have plain walled tanks or provided with cooling tubes or radiators.
The leakage reactance and regulation will be low.

What is yoke section of distribution transformers?
The sections of the core which connect the limbs are called yoke. The yoke is used to provide a closed path for the flux.
6. What are distribution transformers?
The transformers used at the load centres to step down the distribution voltage to a standard service voltage required for consumers are called distribution transformers.
7. What are power transformers?
The transformers used in substations and generating stations for step up the voltage are called power transformers

8. What is the purpose of constructing the pole body by laminated sheets?
The laminated pole offers the homogeneous construction, (Because while casting internal blow holes may develop and while forging internal cracks may develop) Also the laminated poles offers the flexibility of increasing the length by keeping the diameter fixed, in order to increase the power output (or capacity) of the machine.

9. State the use of power transformers

In generating stations the power transformers are used to step up the voltage to a higher level required for the primary transmission.
In substations the power transformers are used to step down the voltage level required for the secondary transmission.

10. Distinguish between core and shell type transformer.
In core type transformer the coil surrounds the core, while in shell type transformer the core surrounds the coil

11. What are the advantages of shell type transformer over core type transformers?
In shell type transformers the coils are well supported on the all sides and so they can withstand higher mechanical stresses developed during short circuit conditions. Also the leakage reactance will be less in shell type transformers.

12. In transformers, why the low voltage winding placed near the core?
The winding & Core are both made of metals and so an insulation have to be placed in between them, the thickness of insulation depends on the voltage rating of the winding. In order to reduce the insulation requirement the low voltage winding place near the core.

13. What is window space factor?
The window space factor is defined as the ratio of copper area in window to total area of window.

Write down the output equation for the1phase and 3 phase transformer.
Output KVA of single phase transformer $Q = 2.22fBmAiKwAw\delta \times 10\text{-}3$
Output KVA of three phase transformer, $Q = 3.33fBmAiKwAw\delta \times 10\text{-}3$

How will you select the emf per turn of a transformer?
The equation of emf per turn in terms of KVA rating, flux frequency and ampere turn is given by,
Emf per turn, $Et = K\sqrt{Q}$
Where $K = \sqrt{4.44f (\phi m/AT)} \times 103$

16. Why circular coils are preferred in transformers?
The excessive leakage fluxes produced during short circuit and over loads, develop severe mechanical stresses on the coil. On circular coils these forces are radial and there is no tendency to change its shape. But on rectangular coils the force are perpendicular to the conductors and tends to deform the coil in circular form.

17. What are the advantages of stepped cores?
For same area of cross section the stepped cores will have lesser diameter of the circumscribing circle than square cores. This results in length of mean turn of the winding with consequent reduction in both cost of copper and copper loss.

18. What are the disadvantages of stepped cores?
With large number of steps a large number of different sizes of laminations have to be used. This results in higher labour charges for sheering and assembling different types of laminations.

19. Define copper space factor.
The copper space factor is the ratio of conductor area and window area in case of transformers.

20. What do you meant by stacking factor (iron space factor)?

In transformers, the core is made of laminations and the laminations are insulated from each other by a thin coating of varnish. Hence when the laminations are stacked to the form the core, the actual iron area will be less than the core area. The ratio of iron area and total core area is called stacking factor. The value is usually 0.9.

21. Why stepped cores are used?

When stepped cores are used the diameter of the circumscribing circle is minimum for a given area of the core. This helps in reducing the length of mean turn of the winding with consequent reduction in both cost of copper and copper loss.

What are the factors to be considered for choosing the type winding for a core type transformer?
Current density
Short circuit current
Temperature rise
Surge voltage
Impedance
Transport facilities

What is tertiary winding?

Some three phase transformers may have a third winding called tertiary winding apart from primary and secondary. It is also called auxiliary winding or stabilizing winding.

24. What is the purpose of tertiary winding?
To supply small additional loads at a different voltage
To give supply to phase compensating devices such as capacitors which work at different voltage.
To limit the short circuit current
To indicate voltage in high voltage testing transformer.

25. How the tertiary winding is connected?
The tertiary winding is normally connected in delta. When the tertiary is connected in delta, the unbalance in phase voltage during unsymmetrical faults in primary and secondary is compensated by the circulating currents flowing in the closed delta.

26 List some methods of cooling of transformers.

Air natural, Air blast, Oil Natural, Oil natural air forced, Oil natural water forced, Oil forced, Oil forced air natural, Oil forced air natural, Oil forced water forced.

27. What are the factors to be considered for choosing the method of cooling?

The choice of cooling method depends on KVA rating of transformer, size, application and the site conditions where it will be installed.

28. How the heat dissipates in a transformer?

The heat dissipation of a transformer occurs by convection, conduction and radiation.

29 Why transformer oil is used as a cooling medium?

When transformer oil is used as a coolant the heat dissipation by convection is 10 times more than the convection due to air. Hence transformer oil is used as a cooling medium.

30. Why cooling tubes are provided?

Cooling tubes are provided to increase the heat dissipating area of the tank.

31. How the heat dissipation is improved by providing the cooling tubes?

The cooling tubes will improve the circulation of oil. The circulation of oil is due to effective pressure heads produced by columns of oil in tubes. The improvement in cooling is accounted by taking the specific heat dissipation due to convection as 35% more than that without tubes.

32. What is a breather?

The breather is a device fitted in the transformer for breathing. In small oil cooled transformers some air gap is provided between the oil level and tank top surface. When the oil is cooled, it shrinks and air is drawn from the atmosphere through breather. This action of transformer is called breathing.

33. Why silica gel is used in breather?

The silica gel is used to absorb the moisture when the air is drawn from the atmosphere in to the transformer.

34. How the leakage reactance of the transformer is reduced?

In transformers the leakage reactance is reduced by interleaving the high voltage and low voltage winding.

UNIT – IV
THREE PHASE INDUCTION MOTORS

1. What are the different types of induction motor and how differ from each other?

The two different types of induction motor are squirrel cage and slip ring induction motor. The stator is identical for both but they differ in construction of rotor.

2. Why wound rotor construction is adopted?

The wound rotor has the facility of increasing the rotor resistance through slip rings. High value of rotor resistance is need during starting to get a high value of starting torque.

3. What is rotating transformer?

The principle of operation of induction motor is similar to that a transformer. The stator winding is equivalent to primary of the transformer and the rotor winding is equivalent to short circuited secondary of a transformer. In transformer the secondary is fixed but in induction motor it is allowed to rotate. Hence the induction motor also called rotating transformer.

4. How the slip ring motor is started?

The slip ring motor is started by using rotor resistance starter. The starter consists of star connected to slip rings. While starting the full resistance is included in the rotor circuit to get high starting torque. Once the rotor starts rotating the resistance is gradually reduced in steps. At running condition the slip rings are shorted and so it is equivalent to squirrel cage rotor.

5. What are the materials used to manufacture the brushes for slip rings of an induction motor?

The slip rings are made of brass and phosphor bronze. The brushes are made of metal graphite which is an alloy of copper and carbon.

What are the advantages of cage rotor over slip ring induction motor?

It is cheaper than slip ring motor

In does not have any wear and tear parts like slip rings, brush gear and short circuiting devices. Hence the construction will be rugged.

No over hang therefore copper loss is less.

Better power factor, and over load capacity

Name the materials used to insulate the laminations of the core of induction motor.

The materials used to insulate the laminations are kaolin and varnish.

What are the advantages of slip ring motor over squirrel cage motor?

The starting torque can be varied by adding resistance to rotor.

The speed of the machine can be varied by injecting an emf through slip rings to the rotor.

Write the expression for the output equation and out coefficient of induction motor.

$Q = C0\ D^2\ LNs$ in KVA

$C0 = 11KwsBav\mathbf{ac} \times 10^{-3}$ in KVA/m3-rps.

10. What are the factors to be considered for choosing the specific magnetic loading?

The choice of specific magnetic loading depends on power factor, iron loss and over load capacity.

11. What are the factors to be considered for the choice of specific electric loading?

The choice of specific loading depends on copper loss, temperature rise, voltage rating and over load capacity.

12. What are the main dimensions of an induction motor?

The main dimensions of induction motor are stator core internal diameter and stator core length.

13. How the induction motor can be designed for best power factor?

For best power factor the pole pitch, τ is chosen such that, $\tau = \sqrt{0.18L}$

14. What are the different types of stator winding in induction motor?

The different types of stator windings are mush winding, lap winding and wave winding.

15. Where mush windings are used?

The mush windings are used in small induction motors of ratings below 5 HP.

16. What types of slots are preferred for the induction motor?

Semi enclosed slots are preferred for induction motor. It results in less air gap contraction factor giving a small value of magnetizing currents, low tooth pulsation loss and much quieter operation(less noise)

17. What is slot space factor?

The slot space factor is the ratio of conductor (or copper) is per slot and slot area. It gives an indication of the space occupied by the conductors and the space available for insulation. The slot space factor for induction motor varies from 0.25 to 0.4.

18. What is the minimum value of slot pitch in induction motor?

The minimum value of slot pitch in three phase induction motor is 15mm.

What are the factors to be considered for selecting number of slots in induction machine stator?

The factors to be considered for selecting the number of slots are tooth pulsation loss, leakage reactance, magnetizing current, iron loss and cost. Also the number of slots should be multiple of slots per pole per phase for integral slot winding.

Which part of induction motor has the maximum flux density? What is the maximum flux density in that part?

The teeth of the stator and rotor core will have maximum flux density. The maximum value of flux density in the teeth is 1.7 wb/m2

What are the factors to be considered for estimating the length of air gap.

Power factor, 2. Unbalanced magnetic pull, 3. Overload capacity
Pulsation loss, 5. Cooling, 6. Noise.

What are the advantages and disadvantages of large air gap length in induction motor?

Advantage: A large air gap length results in higher overload capacity, better cooling, reduction in noise and reduction in unbalanced magnetic pull.

Disadvantages: The disadvantage of large air gap length is that it results in high value of magnetizing current.

23. What happens if the air gap length is doubled?

If the air gap of an induction motor is doubled then the mmf and magnetizing current approximately doubles. Also increase in air gap length increases the overload capacity, offers better cooling, reduces noise and reduces unbalanced magnetic pull.

24. List out the methods to improve the power factor of the induction motor.

The power factor of the induction motor can be improved by reducing the magnetizing current and leakage reactance. The magnetizing current can be reduced by reducing the length of air gap. The leakage reactance can be reduced by the depth of stator & rotor slots, by providing short chorded winding and reducing the overhang in stator winding.

25. Why the air gap of an induction motor is made as small as possible?

The mmf and the magnetizing current are primarily decided by length of air gap. If air gap is small then mmf and magnetizing current will be low, which in turn increase the value of power factor. Hence by keeping small air gap, high power factor is achieved.

Write the formula for air gap in case of three phase induction motor in terms of length and diameter.

The length of air gap, $lg = 0.2 + 2\sqrt{DL}$ in mm

Where D, L are expressed in metre.

Discuss the relative merits and demerits of open and closed slots for induction motor.

The closed slots will not increase reluctance of air gap and has lesser noise but it has difficulty in casting the rotor bars. The open slots increase the reluctance of air gap and has high noise but it offers flexibility in casting rotor bars.

List the undesirable effects produced by certain combination of rotor and stator slots.

The motor may refuse to start (cogging)

The motor may run at sub synchronous speed (Crawling)

Severe vibrations may develop and the noise will be excessive.

What are the different types of windings used for the rotor of induction motor?

The different types of windings employed in induction motor rotor are mush winding and double layer winding.

30. What is crawling and cogging?

Crawling is a phenomena in which the induction motor runs at a speed lesser than the sub synchronous speed.

Cogging is a phenomena in which the induction motor refuse to start.

31. What are the methods adopted to reduce harmonic torques?

The methods used for reduction or elimination of harmonic torques are chording, integral slot winding, skewing and increasing the length of air gap.

32. What is skewing?

Skewing is twisting either the stator or rotor core. The motor noise, vibrations, cogging and synchronous cusps can be reduced or even entirely eliminated by skewing.

UNIT –V

SYNCHRONOUS MACHINES

Name the two types of synchronous machines.

0 Salient pole machines

1 Cylindrical rotor machines.

What are the two type of poles used in salient pole machines?

The two types of poles used in salient pole machines are round pole and rectangular poles.

3. What is run away speed?

The runaway speed is defined as the speed which the prime mover would have, if it is suddenly unloaded, when it is working at its rated load.

4. State three important features of turbo alternator rotors.

The rotors of turbo alternators have large axial length and small diameters.

Damping torque is provided by the rotor itself and so there is no necessity for additional damper winding.

They are suitable for high speed operations and so number of poles is usually 2 or 4.

What are the prime movers used for a) Salient pole alternator, b) Non salient pole alternator. The prime movers used for salient pole alternators are water wheels like Kaplan turbine, Francis turbine, Pelton wheel etc., and diesel or petrol engines. The prime movers used for non-salient pole alternators are steam turbines and gas turbines.

6. Distinguish between cylindrical pole and salient pole construction.

In cylindrical pole construction the rotor is made of solid cylinder and slots are cut on the outer periphery of the cylinder to accommodate field conductors In salient pole construction, the circular or rectangular poles are mounted on the outer surface of the cylinder. The field coils are fixed on the pole. The cylindrical pole construction is suitable for high speed operation , whereas the salient pole construction is suitable for slow speed operations.

7. Salient pole machines are not suitable for high speed operations, why?

The salient pole rotors cannot withstand the mechanical stresses developed at high speed. The projecting poles may be damaged due to mechanical stresses.

8. What is critical speed of alternator?

When the rotor of the alternator has an eccentricity, it may have a deflection while rotating. This deflection will be maximum at a speed called critical speed. When a rotor with eccentricity passes through critical speed, severe vibrations are developed.

9. Mention the uses of damper windings in a synchronous machine?

Damper winding is used to reduce the oscillations developed in the rotor of alternator when it is suddenly loaded.

The damper winding is used to start the synchronous motor as an induction motor.

List the factors to be considered for separation of D and L for salient pole machines.

Peripheral speed

Number of poles

Short circuit ratio

Define pitch factor

The pitch factor is defined as the ratio of vector sum of emf induced in a coil to arithmetic sum of emf induced in the coil

12. Define distribution factor.

The distribution factor is defined as the ratio of vector sum to arithmetic sum of emf induced in the conductor of one phase spread.

13. Why alternators are rated in KVA?

The KVA rating of ac machine depends on the power factor of the load. The power factor in turn depends on the operating conditions. The operating conditions differ from place to place. Therefore the KVA rating is specified for all ac machines.

What are the factors to be considered for the choice of specific magnetic loading?

Iron loss

Voltage rating

Transient short circuit current

Stability

Parallel operation.

Give typical values of flux density an ampere conductor per metre for large turbo alternators.

Bav = 0.54 to 0.65 wb/m2

ac = 50000 to 75000 amp.cond/m (For conventionally cooled machine) ac = 180000 to 200000 amp.cond/m (for water cooled machine)

What are the factors to be considered for the choice of specific electric loading?

Copper loss

Temperature rise

Voltage rating

Synchronous reactance

Stray load losses

17. What is short circuit ratio?

The short circuit ratio is defined as the ratio of field current required to produce rated voltage on open circuit to field current required to circulate the rated current on short circuit. It is also given as the reciprocal of synchronous reactance.

18. How the value of SCR affects the design of alternator?

For high stability and low regulation, the value of SCR should be high, which requires large air gap, when the length of air gap is large, the mmf requirement will be high so the field system will be large. Hence the machine will be costlier.

What are the advantages of large air gap in synchronous machines?
Reduction in armature reaction
Small value of regulation
Higher value of stability
A higher synchronous power which makes the machine less sensitive to load variation
Better cooling
Lower tooth pulsation loss
Less noise
Smaller unbalanced magnetic pull
Determine the total number of slots in the stator of an alternator having 4 poles, 3 phase, 6 slots per pole per phase.
Total no. of slots = slots per pole per phase x no. of poles x no. of phase
0 6 x 4 x 3 = 72 slots

List the influence of the air gap length on the performance of the synchronous machine.
Armature reaction
Noise
Unbalanced magnetic pull
Regulation
Tooth pulsation loss
Sensitivity to load variations

List the factors to be considered for the choice of slot in synchronous machines,
Balanced winding
Cost
Hot spot temperature in winding
Leakage reactance
Tooth losses
Tooth flux density

What is the limiting factor for the diameter of synchronous machine?

The limiting factor of synchronous machine is the peripheral speed. The limiting value of peripheral speed is 175 m/s for cylindrical and 80 m/s for salient pole machines

Write the expression for air gap length in cylindrical rotor machines.
Length of air gap, lg = (0.5SCR ac τ Kf x 10-6)/(Kg Bav)

What are the factors to be considered for selecting the number of poles in an alternator?

The number of poles depends on the speed of the prime mover and frequency of generated emf.

26. Discuss how the ventilation and cooling of large high speed alternator is carried out.

For high speed alternator two cooling methods are available and they are conventional cooling and direct cooling.

In conventional cooling methods, radial and axial ventilating ducts are provided in the core. Cooling is performed by forced circulation of air or hydrogen at a pressure higher than atmosphere.

In direct cooling methods, cooling ducts are provided in the stator and rotor slots or conductor itself will be in the form of tubes. Coolants like water or oil or hydrogen are circulated in the ducts to remove the heat directly from the conductors.

Mention the factors that govern the design of field system of the alternator.
Number of poles and voltage across each field winding
Amp-turn per pole
Copper loss in the field coil
Dissipating surface of field coil
Specific loss dissipation and allowable temperature rise.

Mention the advantages of fractional slot winding.
In low speed machines with large number of poles, fractional slot winding will reduce tooth harmonics
A range of machines with different speeds can be designed with a single lamination
The fractional slot winding reduces the harmonics in mmf and the leakage reactance of the winding.

29. What type of prime movers is used in hydro electric stations depending on the head?

The type of water turbine used in hydroelectric station depends on water head. Pelton wheel is used for water heads of 400 m and above. Francis turbine is used for water heads upto 380 m. Kaplan turbine is used for water heads upto 50m.

List the types of synchronous machines operating on general power supply.
Hydro generators
Turbo generators
Engine driven generators
Motors
Compensators

Give the approximate values of runaway speed of the turbines with full gate opening.

Pelton wheel – 1.8 times the rated speed.
Francis turbine – 2 to 2.2 times the rated speed.
Kaplan turbine – 2.5 to 2.8 times the rated speed.

Write the output equation of a synchronous machine. Q = C0D2Lns in KVA
C0 = 11KwsBav**ac** x 10-3 in KVA/m3-rps.

MARKS

UNIT – 1

1.What are the main groups of electrical conducting materials? Describe the properties and applications of those materials.

Describe any two methods used for determination of motor rating for variable load drives with suitable diagrams.

Discuss about various duties and ratings of rotating machines and give their respective temperature – time curves.

What are the limitations in the design of electrical apparatus?

Deive the equation of temperature rise of a machine when it is run under steady load conditions starting from cold conditions.

Expalin the choice of specific electric and magnetic loadings in designing the rotating machines.

A field coil has a heat dissipating surface of 0.15 m^2 and length of mean turn 1m. It dissipates loss of 150W, the emissivity being 34W/m^2 – ° C. Estimate the final steady temperature rise of the coil and its time constant if the cross section of the coil is 00*50 mm^2. Specific heat of copper is 390J/kg ° C. The space factor is 0.56. Copper weighs 8900 kg/m^3 .

Determine the apparent flux density in the teeth of a dc machine when the real flux density is 2.15 wb/m^2, Slot pitch is 28 mm, slot width is 10 mm and the gross core length 0.35 metre. The number of ventilating ducts is 4. Each duct is 10 mm wide. The magnetizing force for a flux density of 2.15 wb / m^2 is 55000 H/m. The iron stacking factor is 0.9

Calculate the mmf required for the air gap of a salient pole synchronous machine having core length of 0.32 metre including 4 ducts of 10 mm each; pole arc = 0.19 metre. Slot pitch = 65.4. Slot opening = 5 mm. Air gap length = 5mm. Flux per pole 52 mwb.

0 Determine the air – gap length of a dc machine from the following particulars: gross length of the core= 0.12 m , no. of ducts = 1 and is 10 mm wide, slot pitch=25mm, slot width=10mm, carters coefficient for slots and ducts = 0.32 , gap density at pole centre = 0.7 wb/m^2 ; field mmf/ pole= 39000AT, mmf required for iron parts of magnetic circuit = 800 AT

UNIT – II

Calculate the main dimensions of a 50 KW, 4 pole, 600 rpm dc generator from the following data: B_{av}= 0.8 Tesla, ac= 200 amp conductor per cm

$$\frac{\text{poleaCo}\mathbf{r}\text{elengthc} = 0.6, = 0\text{efficiency}.75, = 0.85}{\text{polepitch}}$$

Find the main dimensions and number of poles of a 100 KW, 230V, 1000 rpm shunts motor so that a square pole face os obtained. The average gap density is 0.85 Wb/m^2 and ampere conductor metre are 22000. The ratio of pole arc to pole pitch = 0.67. The full load efficiency is 91%.

Determine the main dimension of a *0 KW. 4 pole, 600 rpm DC shunt generator, The full load terminal voltage being 220V. The maximum gap density is 0.75 Wb/ m^2 and the armature conductors per meter are 27,000. Assume a square pole face.

Design shunt field winding of a 4 pole, 240v DC generator which has the following data. MMF/pole =5060A, mean length of turn = 1.21m, winding depths = 45 mm, cooling surface/ coil = 0.24 m^2. Calculate the inner, outer diameter of the cylindrical coil. Assume 2 micro ohm cm as the resistivity of copper at working temperature.

Determine the total commutator lossesof a DC machines from the given data. Q= 500 KW, 400V, 600 rpm, 4 pole, diameter of commutator = 0.9m, current density at brush contact = $68x\ 10^{-3} A/mm^2$, brush pressure = 13.8 KN/m^2, co efficient of friction = 0.28, brush contact drop = 9 V.

Design suitable commutator for a 350 KW, 600 rpm, 440V, 6 pole dc generator having an armature diameter of 0.75 m. The number of coils is 288.

Data: p=350 KW D = 0.75 m P = 6 V = 440 V N_c=288 N = 600 rpm.

Determine the apparent flux density in the teeth of a dc machine when the real flux density is 2.15 wb/m^2, Slot pitch is 28 mm, slot width is 10 mm and the gross core length 0.35 metre. The number of ventilating ducts is 4. Each duct is 10 mm wide. The magnetizing force for a flux density of 2.15 wb / m^2 is 55000 H/m. The iron stacking factor is 0.9

Calculate the mmf required for the air gap of a salient pole synchronous machine having core length of 0.32 metre including 4 ducts of 10 mm each; pole arc = 0.19 metre. Slot pitch = 65.4. Slot opening = 5 mm. Air gap length = 5mm. Flux per pole 52 mwb.

Expalin the various steps involved in the design of armature winding of DC Machine.

Derive the output equation of a DC Machine and explain specific electric electric and magnetic loadings..

UNIT - III

- The voltage per turn of a 400 KVA, 6.6KV/415v, delta/star, three- phase , core type power transformer is 8.7 V. Calculate the number of turns per phase of the LV and HVwindings and suggest suitable cross sectional area of conductor required. Assume a current density of about 2.85 A/mm^2
- The tank of a 250 KVA single phase oil filled, self – cooled transformer is 100 cm in height and 40 x 70 cm in plan. Total loss to bedissipated on full – load = 3 KW. Determine the arrangement of 5cm diameter cooling tubes spaced about 6 cm between centers and averaging 80 cm in length. Take mean temp rise of the tank as 35 c . Sketch the plan showing the arrangement of tubes.

Estimate the main core dimensios, number of turns in the two windings and the conductor sections in a 25kVA, 3 phase 6.6 kV/440V, 50Hz, delta/star core type transformer with the following data: stepped core with space factor = 0.56: space factor for winds = 0.25: voltage per turn = 9V: current density = 3.26 A/mm^2:maximum flux density = 1.1 T.

The voltage per turn of a 400 kVA, 6.6kV/415Vdelta/star, three – phase, core type power transformer is 8.7V. Calculate the numper of turns perphase of the LV and HV windings and suggest suitable cross sectional area of conductor required>Assume current density of about 2.85 A/mm^2

Calculate the dimension of the core, the number of turns and cross sectional area of conductors in the primary and secondary windings of a 100 kVA, 2300/400V, 1 – phase shell type transformer. Ratio of magnetic and electric loading equal to $480X10^{-8}$(i.e., flux and secondary mmf at full load).B_m=1.1 Wb/m^2, δ=2.2A/mm^2,K_w=0.3,Stacking factor = 0.9

The tank of 1250 KVA, natural oil cooled transformer has the dimensions length, width and height as 1.55X0.65X1.85 m respectively. The full load loss =13.1 KW, loss dissipation due to radiations = 6 W/ m^2 -˚C,loss dissipation due to convection = 6.5 W/ m^2 -˚C, Improvement in convection due to provision to tubes = 50 mm. Find the number of tubes for this transformer. Neglect the top and bootom surface of the tank as regards the cooling.

Derive the output equation of a 1 phase transformer in terms of core and window area.

Derive the output equation of transformer for both 3 phase from basis and also explain the transformer for minimum losses.

Discuss about the various cooling methods method of cooling of transformer.

Derive the condition for minimum cost in transformer.

UNIT – IV

Describe the importance of dispersion coefficient and power factor in the design of induction motor.

Explain why the air – gap of induction motor is made as small as possible.

Derive an expression for the equivalent resistance of cage rotor referred to stator per phase three phase induction motor.

Determine the approximate diameter and length of stator core the number of stator slots and the number conductor for a 20 KW, 400V, 4 pole, 1200 rpm,Δ connected induction

0 =0.82, ac=26000 amp.cond/m, p.f=0.8L/ τ =1, double layer statormotor.B_{av}=0.5T,
winding.

Estimate the main dimensions, air – gap length, stator slots, stator turns/phase, 110 KW,3300V, 50Hz, 10 poles,600 rpm induction motor.

B_{av}=0.48 Wb/m^2 , ac= 28000 L/ τ =1.25, η =0.9,p.f = 0.86.

Design cage rotor for a 18,8 HP, 3 phase ,440V, 50Hz, 100 rpm, induction motor having a full load efficiency of 0.86 and a power factor of 0.86 D= 0.25m, L= 0.14m Z_s/slot = 28,S_s=54 Assume missing data if any .

Derive the output equation of ac machine in terms of the main dimension.

Discuss about the effect of short circuit ratio on the performance of synchronous machine.

Write short notes on (i) Design of rotor bars and slots (ii) Design of end rings

Discuss the effects of the following on the performnace of three phase induction motor.
(i) Number of stator slots (ii) Length of air gap.

UNIT – V

A 500 kVA, 3.3 kV50Hz, 600 rpm, 3 – phase salient pole alternator has 200 turns per phase. Estimate the length of the air – gap if the average flux density is 0.55 T, the ratio of pole arc to pole pitch is 0.65, short circuit ratio is 1.15, gap expansion factor is 1.15, mmf required for the gap is 80% of no load field mmf and winding factor is 0.955.

Lis the considerations in the design of field windings of salient pole alternator.

Explain what steps are taken to ensure that an alternator shall generate an e.m.f, the waveform of which shall be close approximation to a sine wave.

Determine for a 15 MVA, 11 KV, 50 Hz, 2 pole, star connected turbo alternator (i) air – gap diameter, (ii) core length (iii) number of stator conductors from the given data, B_{av}=0.55Wb/m_2,ac= 36000 A/m, δ =5 A/mm_2, synchronous speed, n_s=50 rps,K_{WS}=0.98, Peripheral speed =160 m/s.

A 3 phase alternator has a stator bore of 1,70m and core length of 0.35m. The average gap density is approximatelys0.55 Wb/m^2.Determine the suitable number of slots and conductors per slot for a terminal voltage of 6600V,50 Hz and 375 rpm.Use star connection.

Derive the output equation of a synchronous machine.

Discuss the factors affecting the choice of specific magnetic loading in an alternator.

For what purpose damper winding is used in 3- phase synchronous motor and explain in detail about design of damper winding with all necessary equations.

State the factors governing the choice of average flux density in the air gap and ampere conductors per meter in the design of three phase synchronous machine.

Explain the step by step procedure for the design of field winding of synchronous machine.

POWER SYSTEM TRANSIENTS
UNIT I
INTRODUCTION TO SURVEY

What are the types of source of transients?
Lightning
Switching
Temporary voltage
Very fast transient voltage.

2. What is power system analysis?
The evaluation of power system is called as power system analysis.

3. Define energizing quantity.
It refers to the current or voltage which is used to activate the relay into operation.

4. What is biased differential bus zone reduction?
The biased beam relay is designed to respond to the differential current in terms of its fractional relation to the current flowing through the protected zone. It is essentially an over-current balanced beam relay type with an additional restraining coil. The restraining coil produces a bias force in the opposite direction to the operating force.

Mention the short comings of Merz Price scheme of protection applied to a power transformer.
In a power transformer, currents in the primary and secondary are to be compared. As these two currents are usually different, the use of identical transformers will give differential current, and operate the relay under no-load condition. Also, there is usually a phase difference between the primary and secondary currents of three phase transformers. Even CT's of proper turn-ratio are used, the differential current may flow through the relay under normal condition.

What are the various faults to which a turbo alternator is likely to be subjected?
Failure of steam supply; failure of speed; overcurrent; over voltage; unbalanced loading; stator winding fault.

What is the voltage of basic insulation level & basic switching level?
- Basic insulation level =1050KV
- Basic switching level =950KV

Define surge tank.
Surge tanks are tanks connected to the water conductor system. It serves the purpose of reducing water hammering in pipes which can cause damage to pipes. The sudden surges of water in penstock is taken by the surge tank, and when the water requirements increase, it supplies the collected water thereby regulating water flow and pressure inside the penstock.

9. Define Isokeraunic level or thunderstorm days.
It is defined as the number of days in a year when the thunder is heard or recorded in a particular location. Often it does not distinguish between the ground strokes and the cloud-to-cloud strokes.

State the factors influence the lightning induced voltages on transmission lines.
The ground conductivity, the leader stroke current and the corona.

State the attenuation and distortion of travelling waves.
The decrease in the magnitude of the wave as it propagates along the line is called attenuation. The elongation or change of wave shapes that occur is called distortion.

12. How are the insulation level and the protective safety margin arrived?
Selecting the risk of failure, the statistical safety factor and by firing the withstand level of any equipment or apparatus corresponding to 90% or 95% of the withstand voltage

UNIT-II
SWITCHING TRANSIENTS
What are the various faults that would affect an alternator?
(a) Stator faults
1, Phase to phase faults
2, Phase to earth faults
3, Inter turn faults
1, Earth faults 2,
Fault between turns
3, Loss of excitation due to fuel failure
1, Over speed
2, Loss of drive
3, Vacuum failure resulting in condenser pressure rise, resulting in shattering of the turbine low pressure casing
1, Fault on lines
2, Fault on bus bars

2. What are the main safety devices available with transformer?
Oil level guage, sudden pressure delay, oil temperature indicator, winding temperature indicator.

What are the problems arising in differential protection in power transformer and how are they overcome?
Difference in lengths of pilot wires on either sides of the relay. This is overcome by connecting adjustable resistors to pilot wires to get equipotential points on the pilot wires.
Difference in CT ratio error difference at high values of short circuit currents that makes the relay to operate even for external or through faults. This is overcome by introducing bias coil.
Tap changing alters the ratio of voltage and currents between HV and LV sides and the relay will sense this and act. Bias coil will solve this.
Magnetizing inrush current appears wherever a transformer is energized on its primary side producing harmonics. No current will be seen by the secondary. CT's as there is no load in the circuit.

4. Define Basic Impulse Level.

It is defined as the minimum insulation impulse withstands voltage of any power equipment or apparatus. The BIL of a power system is usually chosen as 25% to 30% more than the protective level offered by the protective devices.

5. What are inelastic collisions?
They are those in which internal changes in energy takes place within an atom or a molecule at the expense of the total kinetic energy of the colliding particle. The collision often results in a change in the structure of the atom.

6. What are the causes of bus zone faults?
Failure of support insulator resulting in earth fault
Flashover across support insulator during over voltage
Heavily polluted insulator causing flashover
Earthquake, mechanical damage etc.

7. Define collision cross section.
It is defined as the area of contact between two particles during a collision. In other words the total area of impact.

8. What is ionization?
The process of liberating an electron from a gas molecule with a simultaneous production of a positive ion is called ionization.

9. What is power swing?
During switching of lines or wrong synchronization surges of real and reactive power flowing in transmission line causes severe oscillations in the voltage and current vectors. It is represented by curves originating in load regions and traveling towards relay characteristics.

10. What is CPMC?
It is combined protection, monitoring and control system incorporated in the static system.

11. Define Resistance switching.
It is the method of connecting a resistance in parallel with the contact space(arc). The resistance reduces the restriking voltage frequency and it diverts part of the arc current. It assists the circuit breaker in interrupting the magnetizing current and capacity current.

12. What do you mean by current chopping?
When interrupting low inductive currents such as magnetizing currents of the transformer shunt reactor, the rapid deionization of the contact space and blast effect may cause the current to be interrupted before the natural current zero. This phenomenon of interruption of the current before its natural zero is called current chopping.

What are the methods of capacitive switching?
•Opening of single capacitor bank
•Closing of one capacitor bank against another

14. State the properties of good dielectrics.
Low dielectric loss, high mechanical strength, should be free from gaseous inclusions and moisture and be resistant to thermal and chemical deterioration.

15. What is meant by ferro resistance?
The variation of input voltage that is insufficient duration to allow visual vibration of a change in electric light source intensity.

16. What is the difference between restrikes & multiple restrikes?
That's because it's harder for them to reach peak demand during the day when everyone's running AC. So they might charge less in the evenings to try to get you to move some of your consumption (like laundry machines) outside of those daytime hours. And even if your utility doesn't have cheaper rates at night, if your utility has a demand charge it could pay to shift your laundry to the evenings, because running laundry + air conditioning at the same time results in a higher demand.

17. What is meant by recovery voltage?
The power frequency RMS voltage appearing across the breaker contacts arc is extinguished and transient oscillations die out is called recovery voltage.

18. How the conductors return to ground?
Modal quantities travel both conductor returns to ground.

Write any two applications of switching?
- Design of carrier propagation.
- Radio interference.
- Control band of instrument.

UNIT- III
LIGHTNING TRANSIENTS

1. What are the classifications of high voltages?
High dc , high ac of power frequency , high ac of high frequency and impulse voltages.

2. What is RRRV?
It is the rate of rise of restriking voltage, expressed in volts per microsecond. It is loosely associated with natural frequency of oscillation.

Write the classification of circuit breakers based on the medium used for arc extinction?
- Air break circuit breaker
- Oil circuit breaker
- Minimum oil circuit breaker
- Air blast circuit breaker
- SF6 circuit breaker

4. Mention few drawbacks of core type furnace.
Due to poor magnetic coupling , leakage reactance is high and power factor is low Low frequency supply is required.

State the advantage of core less induction furnace
- Time taken to reach the melting temp is less
- There is no smoke and noise

What are the hazards imposed by oil when it is used as an arc quenching medium?
There is a risk of fire since it is inflammable. It may form an explosive mixture with arc. So oil is preferred as an arc quenching medium.

What are the advantages of oil as arc quenching medium?
It absorbs the arc energy to decompose the oil into gases, which have excellent cooling properties
It acts as an insulator and permits smaller clearance between line conductors and earthed components

8. Why faults occur in a power system?
The faults occur in a power system due to
Insulation failure of equipment
Flashover of lines initiated by a lighting stroke
Due to permanent damage to conductors and towers or due to accidental faulty operations.

List the various types of faults.
(i) Series fault or open circuit fault
- One open conductor fault
- Two open conductor fault (ii)

Shunt fault or short circuit fault.
- Symmetrical fault or balanced fault
- Three phase fault
- Unsymmetrical fault or unbalanced fault
- Line to ground (L-G) fault
- Line to Line (L-L) fault
- Double line to ground (L-L-G) fault

What are demerits of MOCB?
Short contact life.
Frequent maintenance.
Possibility of explosion.
Larger arcing time for small currents.
Prone to restricts.

11. How is impulse waves specified?
By defining the rise of front time, fall times to 50% peak value and the value ofthe peak voltage.
12. Mention the factors contributing to good line design.
In the laboratory with a combination of a series R-L-C circuit under over damped conditions or by the combination of 2 R-C circuits.

What are the disadvantages of MOCB over a mechanism of lighting strokes?
- The degree of carbonization is increased due to smaller quantity of oil
- There is difficulty of removing the gases from the contact space in time
- The dielectric strength of the oil deteriorates rapidly due to high degree of Carbonization.

What is sub transient reactance?
The synchronous reactance is the ratio of induced emf on no load and the sub transient symmetrical rms current.

UNIT- IV
TRAVELLING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS

1. How does the over voltage surge affect the power system?
The over voltage of the power system leads to insulation breakdown of the equipments. It causes the line insulation to flash over and may also damage the nearby transformer, generators and the other equipment connected to the line.
2. What is pick up value?
It is the minimum current in the relay coil at which the relay starts to operate.

3. Define target.
It is the indicator used for showing the operation of the relay.
4. Define reach.
It is the distance upto which the relay will cover for protection.

5. Define blocking.
It means preventing the relay from tripping due to its own characteristics or due to additional relays.

6**. Mention the problems associated with bifilar strip design.**
The shunt suffers from stray inductance associated with resistance element and its potential leads are linked to a small part of the magnetic flux generated by the current that is measured.

Mention the different ways in which the stray effect is reduced in resistance shunt? Bifilar flat strip design, Co-axial tube or park's shunt design and Co-axial squirrel Cage design.

Specify the 2 types of arrangements in sphere gaps.
Vertically with lower sphere grounded and horizontally with bith spheres connected to the source voltage or one sphere grounded.

9. State the advantages of Sphere gaps?
They are used for voltage measurements. They are suitable for all types of waveforms from d.c to impulse voltages of short times. They are used for radio frequency a.c voltage peak measurements upto 1 MHz.

10. Mention the advantages of field tests.
The circuit breaker is tested under actual conditions like those that occur in the network. Special occasions like breaking of charging currents of long lines ,very short line faults ,interruption of small inductive currents etc… can be tested by direct testing only.

UNIT- V
TRANSIENTS IN INTEGRATED POWER SYSTEM

1. State the various types of earthing.
Solid earthing, resistance earthing, reactance earthing , voltage transformer earthing and zig-zag transformer earthing.

2. State voltage transients on closing and reclosing lines.
Frechner's Law states that the same percentage change in stimulus calculated from the least amount perceptible gives the same change in sensation. Inverse Square Law states that the intensity of i voltage transients on closing and reclosing lines produced by a point source varies inversely as square of the distance from the source.

3. Define withstand test voltage.
The voltage which has to be applied to a test object under specified conditions in a withstand test is called withstand voltage.

4. Define switching surges on integrated system.
The voltage that causes a flashover at each of its applications under specified conditions when applied to test objects as specified is called switching surges on integrated system.

5. What is a surge diverter?
It is a non-linear resistor in series with a spark gap kept at line terminals in the substations.

6. What is the function of surge arrester?
They are capable of discharging 10 to 20 KA of long duration surges and 100 to 250 KA of short duration surge currents.

7. Define type test.
They are intended to prove or check the design features and the quality. They are done on samples when new designs or design changes are introduced

8. Define candle power.
It is defined as the no. of lumens emitted by that source per unit solid angle in a given direction. The term candle power is used interchangeably with intensity.

PART-B

UNIT – I Introduction and Survey

a) Analyze the sources and effects of transients on power systems?

0 Categorize the internal causes for transients.

Discuss the significance of transient studies in power system planning

Examine about double frequency transients and basic transforms of RLC circuit

0 Discuss the various types of power system transient's

Define Transient. Describe in detail about its importance

0 Explore the classifications of power system transients?

Explain briefly about source of Transients

0 Demonstrate with neat diagrams about the types of power system transients

Examine the sources of transients? Also explain how transients affect the power systems.

0 Write a short note on voltage surge.

UNIT-II

SWITCHING TRANSIENTS

Evaluate an expression for the transient currents in a RLC circuit when (i) R=0 (ii) R=2/4 V=11LC

Discuss (i) Current Chopping (ii) Resistance Switching

Examine the phenomenon in switching transient

Differentiate between normal and abnormal switching transients in load switching

Discuss about current suppression?

0 Explain in detail about the simulation of switching surges and Ferro resonance effect-

Explain the control of switching surges and highlight how switching surges affects capacitive Current

Explain load switching with equivalent circuit

Discuss the switching in both normal and abnormal conditions with neat sketches.

Explore the concept of capacitance switching? Explain the effect of source regulation and capacitance switching with one and multiple restrikes.

UNIT-III

LIGHTNING TRANSIENTS

Sketch the characteristics of lightning strokes and also discuss parameters of lightning flash

0 Analyze the factors that contribute to good line design?

Evaluate the interaction between lightning and power system.

Derive an expression for the mathematical model for lightning.

Explain the mechanism of lightning discharge and concept of tower footing resistance.

0 Analyze the characteristics of lightning strokes

Discuss about cloud and charge formation with the aid of various theories

Explain about grounding a line structure and protection offered by ground wires.

0 Investigate the mechanism of the lightning phenomenon and also interpret about the stepped leader

Explain direct lightning strokes to overhead lines, with and without shield wires.

UNIT-IV
TRAVELLING WAVES ON TRANSMISSION LINE COMPUTATION OF TRANSIENTS

Explore the steps involved in Bewely's lattice diagram construction with an example
Evaluate the value of current in a transmission line considering its series and shunt lumped parameters.
0 Draw the step response of a travelling wave. Explain it by using Bewely's lattice diagram
Discuss elaborately on reflection and refraction of travelling waves
Examine multi-velocity waves of travelling waves in transmission lines
Explain multi-conductor system of travelling waves in transmission lines
Develop wave equation of travelling waves in transmission lines
Describe the transient response of systems with series and shunt distributed parameters.
0 Examine the behavior of travelling waves at open circuited transmission line.
10. Describe briefly about standing waves and Standing Wave Ratio (SWR)

UNIT-V
TRANSIENTS IN INTEGRATED POWER SYSTEM

Discuss in detail about EMTP for the applications of transient computation.
Discuss about the distribution of voltage in a power system. Derive the voltage transient on closing lines.
Analyze the computation of Transients in power system using EMTP
. Examine the switching surges in a power system and also outline the concept of line dropping and load rejection in an Power system
Interpret the need for simulation studies. Also describe the key points of EMTP software and the steps involved to do a simulation study of a sample power system-
Develop an expression for response and recovery voltage of a shorted line
Discuss the causes of transients on closing and reclosing of transmission lines
Discuss in detail about the switching surges on an integrated power system
0 Evaluate the reflection and transmission coefficient in an integrated power system
Describe in detail about the causes of over voltages induced by various faults occurring in a power System