CMR INSTITUTE OF TECHNOLOGY	Roll No			

Internal Assessment Test - III

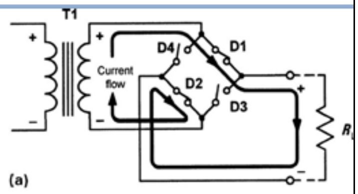
Sub:	Basic Electronics and Communication Engineering					Code:	21ELN14
Date:	31/03/22, 8.30 AM	Duration:	90 mins	Max Marks:	50	Sem: I	SEC: I,J,K,L,M,N,O

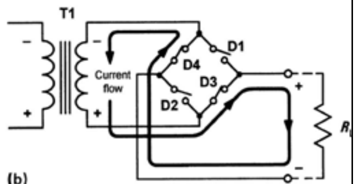
Answer Any **FIVE FULL** Questions

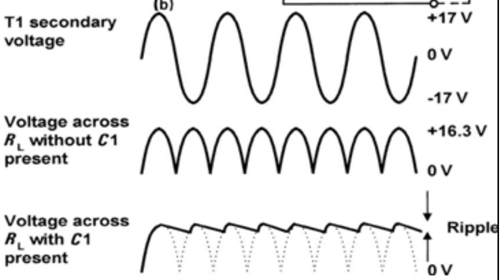
		Marks	OBE CO	OBE RBT
1.	With neat circuit diagram and waveforms explain the working of bridge rectifier.	[10]	CO1	L3

OPERATION OF BRIDGE RECTIFIER

- On positive half cycles, point A will be positive with respect to B. D1 and D2 will conduct and D3 and D4 will not conduct
- On negative half cycles, point B will be positive with respect to A, D3 and D4 will conduct and D1 and D2 will not conduct.
- The current is routed through the load in the same direction on successive half cycles.
- Similar to bi-phase rectifier, the switching action of the two diodes results in a pulsating output voltage being developed across (RL)
- The peak voltage is approximately 16.3V (i.e 17V less the 0.7V forward threshold voltage)

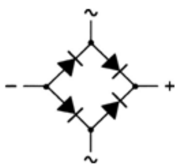


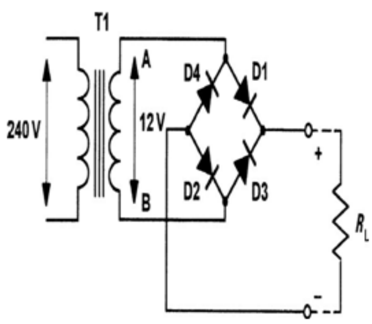




WHAT IS A BRIDGE RECTIFIER?

- ❑An alternative to the use of the bi-phase circuit is that of using a four-diode bridge rectifier in which opposite pairs of diode conduct on alternate half-cycles. This arrangement avoids the need to have two separate secondary windings.
- ❑Mains voltage (240 V) is applied to the primary of a step-down transformer (T1).
- ❑The secondary winding provides 12 V r.m.s. (approximately 17 V peak) and has a turns ratio of 20:1, as before.





		Marks	CO	RBT
2.	Sketch the circuit of each of the following based on the use of operational amplifiers (a) Comparator (b) a Differentiator (c) an Integrator (d) Inverting Amplifier.	[10]	CO1	L2

- **Comparators:**
- The output voltage produced by the operational amplifier will rise to the maximum possible value (equal to the positive supply rail voltage) whenever the voltage present at the non-inverting input exceeds that present at the inverting input.
- Output voltage produced by the op-amp will fall to the minimum possible value whenever the voltage present at the inverting input exceeds that present at the non-inverting input.

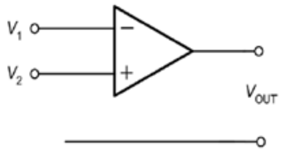


Figure 8.17 A comparator

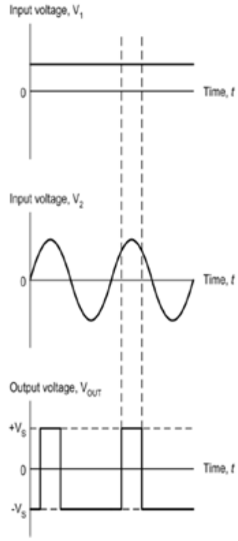


Figure 8.18 Typical input and output waveforms for a comparator

Differentiators:

- A differentiator produces an output voltage that is equivalent to the rate of change of its input.
- This simply means that if the input voltage remains constant (i.e. if it isn't changing) the output also remains constant.
- The faster the input voltage changes the greater will the output be.
- In mathematics this is equivalent to the differential function.

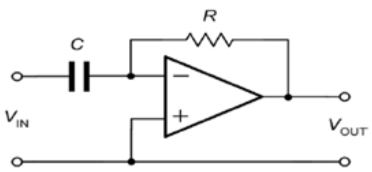


Figure 8.13 A differentiator

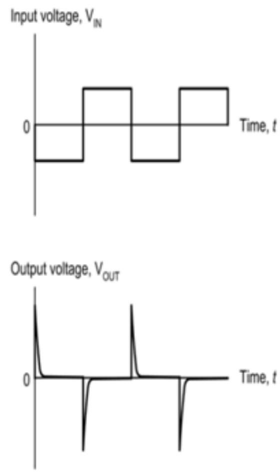


Figure 8.14 Typical input and output waveforms for a differentiator

- **Integrators:**
- This circuit provides the opposite function to that of a differentiator (see earlier) in that its output is equivalent to the area under the graph of the input function rather than its rate of change.
- If the input voltage remains constant (and is other than 0 V) the output voltage will ramp up or down according to the polarity of the input.
- The longer the input voltage remains at a particular value the larger the value of output voltage (of either polarity) will be produced.

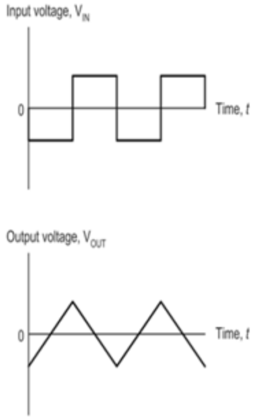


Figure 8.16 Typical input and output waveforms for an integrator

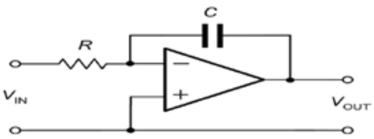
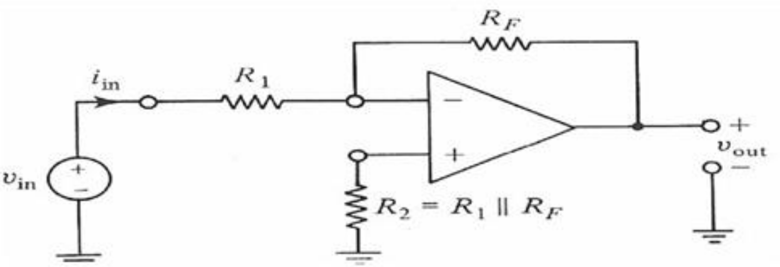


Figure 8.15 An integrator

Operational amplifier configurations

- Inverting amplifier



- Circuit consists of an op-amp and three resistors.
- The positive (+) input to the op-amp is grounded through R_2.
- The negative (-) input is connected to the input signal (via R_1) and also to the feedback signal from the output (via R_F).

3.	A. List and explain conditions for sustained oscillations. Determine the frequency of oscillation of a three-stage ladder network in which C=20 ηF and R=15 kΩ.	[5]	CO1	L3

Conditions for oscillations

a) the feedback must be positive (i.e. the signal fed back must arrive back in-phase with the signal at the input);

b) the overall loop voltage gain must be greater than 1 (i.e. the amplifier's gain must be sufficient to overcome the losses associated with any frequency selective feedback network).

- To create an oscillator we simply need an amplifier with sufficient gain to overcome the losses of the network that provide positive feedback.
- Assuming that the amplifier provides 180° phase shift, the frequency of oscillation will be that at which there is 180° phase shift in the feedback network.
- A number of circuits can be used to provide 180° phase shift, one of the simplest being a three-stage C–R ladder network that we shall see now.

Ladder network oscillator

- **Determine the frequency of oscillation of a three-stage ladder network oscillator in which C = 10 nF and R = 10 kΩ.**

Using

$$f = \frac{1}{2\pi \times \sqrt{6}CR}$$

gives

$$f = \frac{1}{6.28 \times 2.45 \times 10 \times 10^{-9} \times 10 \times 10^{3}}$$

from which

$$f = \frac{1}{6.28 \times 2.45 \times 10^{-4}} = \frac{10^{4}}{15.386} = 647 \text{ Hz}$$

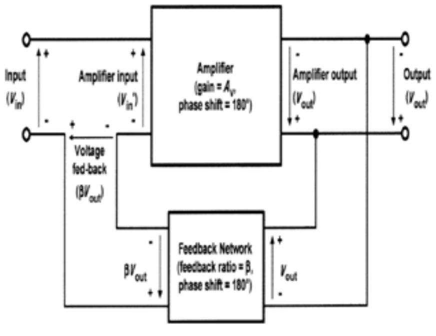
B. With relevant equations and diagram explain the concept of negative feedback.	[5]	CO1	L2

Negative feedback

- Negative feedback used to precisely control the gain, reduce distortion and improve bandwidth.
- The gain can be reduced to a manageable value by feeding back a small proportion of the output.
- The amount of feedback determines the overall (or **closed-loop**) gain.
- Negative feedback has the effect of reducing the overall gain of the circuit

Block diagram of an Amplifier with Negative Feedback

$$G = \frac{V_O}{V_S}$$



Amplifier with negative feedback applied

➤ By applying Kirchhoff's Voltage Law

$$V_s - V_i - \beta V_O = 0$$

$$V_s = V_i + \beta V_O$$

$$A = \frac{V_O}{V_i}$$

$$V_O = AV_i$$

$$G = \frac{AV_i}{V_i + A\beta V_i}$$

$$G = \frac{A}{1 + A\beta}$$

➤Therefore, the overall gain with negative feedback applied will be less than the gain without feedback.

4. Define the following terms: Multipath, Constructive and destructive interference, Coherence time, Coherence bandwidth, Delay spread. [10] CO4 L1

Multipath and Fading

- As a result of reflections, rays can take several different paths from the transmitter to the receiver. This phenomenon is known as **multipath**.
- At the receiver, the incoming rays can add together in different ways, which are shown in figure below.
- If the peaks of the incoming rays coincide then they reinforce each other, a situation known as ***constructive interference***.
- peaks of one ray coincide with the troughs of another, the result is ***destructive interference***, in which the rays cancel.
- Destructive interference can make the received signal power drop to a very low level, a situation known as ***fading***.

- The amplitude and phase of the received signal vary over a timescale called the ***coherence time***, Tc which can be estimated as follows:

$$T_C = \frac{1}{f_D}$$

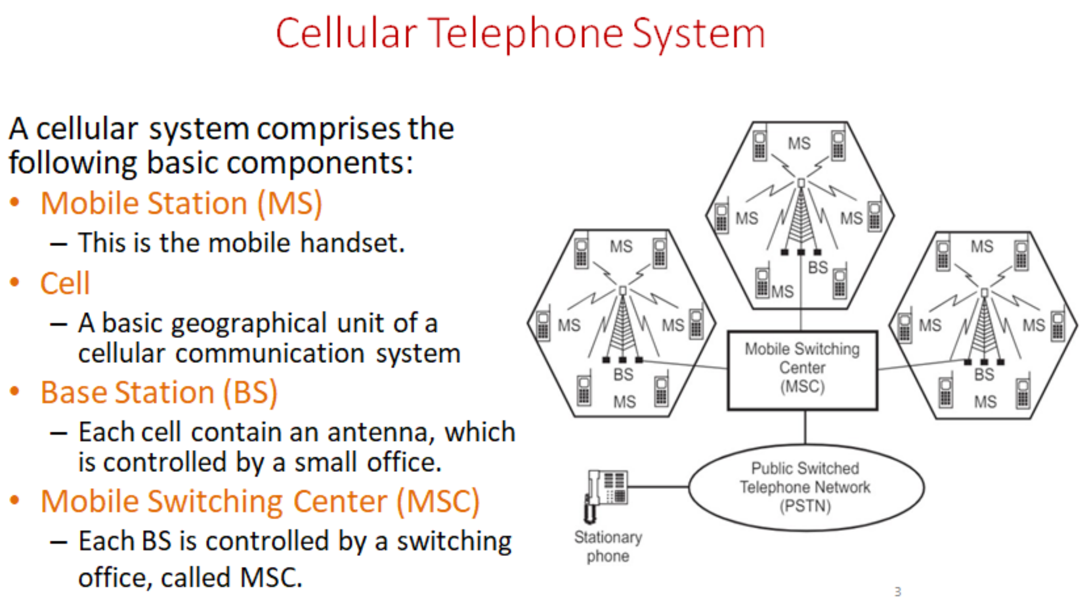
Here f_D is the mobile's Doppler frequency:

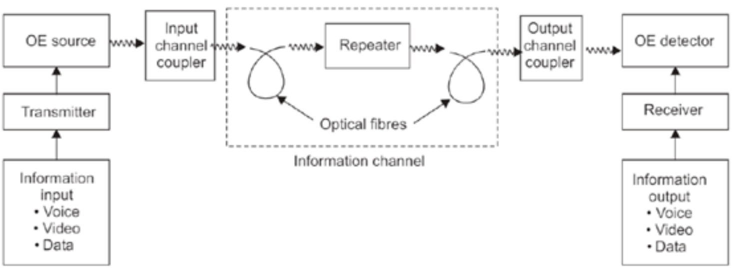
$$f_D = \frac{v}{c} f_c$$

•where f_c is the carrier frequency, v is the speed of the mobile and c *is* the speed of light (3×10^8 ms^{-1})

•The amplitude and phase of the received signal vary over a frequency scale called the

	•If the carrier frequency changes, then the wavelength of the radio signal chang This also makes the interference pattern change between constructive and destructive •The amplitude and phase of the received signal vary over a frequency s called the *coherence bandwidth,* B_c which can be estimated as follows: $B_c = \frac{1}{r}$ Here, r is the delay spread of the radio channel			

5.	A. Draw the schematic diagram of a cellular telephone system and define its basic components  	[6]	CO5	L2
	B. Define the following terms with respect to GSM system: Mobile Station (MS), Base Station Subsystem (BSS), Network & Switching System (NSS)	[4]	CO5	L2

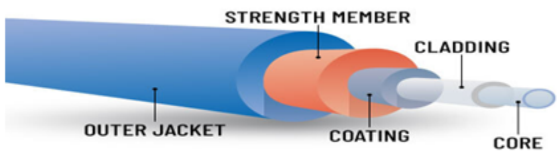
	GSM System Architecture ❑ It consists of three major subsystems that interact with each other and with the subscribers through specified network interfaces. The three subsystems are as follows: • Mobile station (MS) • Base station subsystem (BSS) • Network and switching subsystem (NSS) ❑ **Mobile Station (MS):** The MS consists of the physical equipment used by the subscriber to access a mobile network for offered telecommunication services. Functionally, the MS includes a Mobile Terminal (MT) and, depending on *the* services it can support, various Terminal Equipment (TE), and combinations of TE and Terminal Adaptor (TA) functions (the TA acts as a gateway *between* the TE and *the* MT). ❑ a MS contains the Mobile equipment (ME) and Subscriber Identity Module (SIM), ❑ An MS can be identified as the International Mobile Equipment Identity (IMEI), the International Mobile Subscriber Identity (IMSI) which is stored in SIM and the ISDN number 26 • **Base Station Subsystem (BSS):** The BSS is the physical equipment that provides radio coverage to prescribed geographical areas, known as the cells. It contains equipment required to communicate with the MS. • a BSS consists of a control function carried out by the base station controller (BSC) and a transmitting function performed by the BTS. • The BTS contains the Transcoder Rate Adapter Unit (TRAU). • **Network and Switching Subsystem (NSS):** The NSS includes the main switching functions of GSM, databases required for the subscribers, and mobility management. Its main role is to manage the communications between GSM and other network users. Subscriber information relevant to provisioning of services is kept in the home location register (HLR). The other database in the OSS is the visitor location register (VLR).			
6.	Explain the optical fiber communication system with a block diagram. OPTICAL FIBER COMMUNICATION • **Fiber-optic communication** is a method of transmitting information from one place to another by sending over light as carrier through an optical fiber.  **Fig. 10.15** Generalized configuration of a fiber-optic communication system Blocks of the fiber optic communication system 30-Mar-22 5	[10]	CO5	L1

- **Information input :**
  - Information is in several physical forms for e.g voice, video and data.
  - Transducer is required to convert the physical signal to electrical signal
  - Example: microphone converts the sound signal to electrical signal
  - In situations where the fiber-optic link forms a part of a larger system, the information input is normally in electrical form
- **Transmitter(Modulator):**
- i) converts the electrical signal to proper form ii) impresses the signal onto EM wave(carrier) generated by optoelectronic source
- Modulation can be achieved by analog /digital signal.
- Analog signal varies continuously and reproduces form of information input, for digital modulation, signal is obtained in discrete form
- the linearity needed for analog modulation therefore, analog fiber-optic systems are limited to shorter distances and lower bandwidths.

Optoelectronic source:

- This generates the em wave in optical range (near the IR range of spectrum)
- This em wave(light)acts as a carrier.
- Common sources for fiber-optic communication are the light-emitting diode (LED) and the injection laser diode (ILD).
- Important properties of sources: compact, light weight,moderate power dissipation and easy to modulate.
- LEDs and laser diodes which emit frequencies that are less attenuated while propagating through optical fibers
- **Channel Coupler** : It collects light signal from the optoelectronic source and sends it efficiently to the optical fiber cable.
- Coupling losses may be large due to Fresnel reflection and limited light gathering capacity of the couplers.
- Several designs are used.

30-Mar-22 7

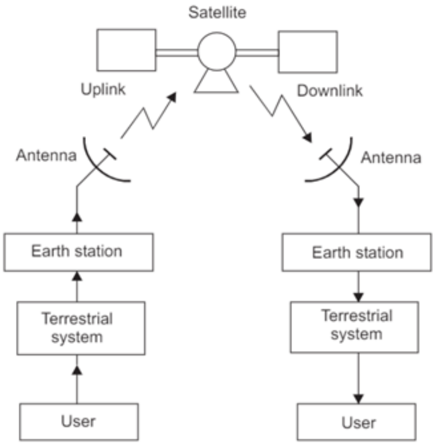


- Fiber-optic Information Channel
- This is a path between the transmitter and receiver.
- In an optical system, channel means the optic cable consisting of single or bundle of fibers madeup of thin strand of ultra pure glass designed to transmit the optical signals from optical source to optical detector
- it consists of two main regions: *(i)* a solid cylindrical region of diameter 8-100 pm Called the core and *(ii)* a coaxial cylindrical region of diameter normally 125 cm called the cladding.
- The information channel should have low attenuation for the frequencies being transmitted through it and a large light gathering capacity.
- The channel must have low dispersion in both time and frequency domains, because dispersion causes distortion of the propagating signals.

7.	Draw the block diagram showing the basic elements of a satellite communication system and briefly explain them.	[10]	CO5	L2

Satellite communication

- Basic elements of the Satellite communication system



The basic elements of a satellite communication system are:

- User
- Satellite
- Terrestrial Network
- Earth Station

Example of uplink /downlink frequency used : C band – 6/4 GHz

Higher freq for uplink and lower freq for downlink.
Frequencies are different to avoid interference

Description of the elements of the Satellite communication

- **User**: The user generates baseband signal that proceeds through a terrestrial network and transmitted to the satellite from earth station.
- **Satellite** : Repeater in space, receives the Rf modulated carrier from all earth stations in the uplink and amplifies before sending in the downlink. To avoid interference, downlink and uplink frequency spectrums should be separate and different.
- **Terrestrial network: T**his is a network on ground which carries the signal from user to earth station. It can be a telephone switch or a dedicated link between the user and the earth station.
- **Earth station:** It is a radio station located on earth, that sends /receives the signals from satellites. It governs all the transmission

8.	Explain the following with the help of waveforms. (i) PAM (ii)PWM (iii)PPM (iv) PCM	[10]	CO4	L2

Pulse Amplitude Modulation(PAM)

- ❑ PAM is the simplest form of pulse modulation
- ❑ In PAM , the signal is sampled at regular intervals, and each sample is made proportional to the amplitude of the signal at the instant sampling.
- ❑ The ability to use constant-amplitude pulses is a major advantage of pulse modulation

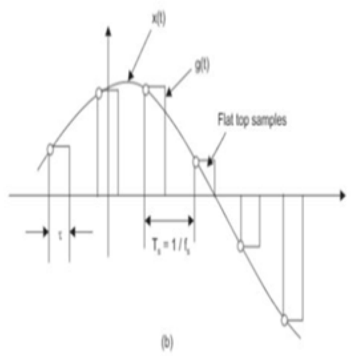


Fig. 6.5 (a) Sample and hold circuit to generate PAM (b) Waveform of PAM

Pulse width or Pulse duration modulation(PWM or PDM)

❑Starting time and amplitude of the pulse are constant but the width or duration of each pulse is made proportional to the instantaneous value of analog signal

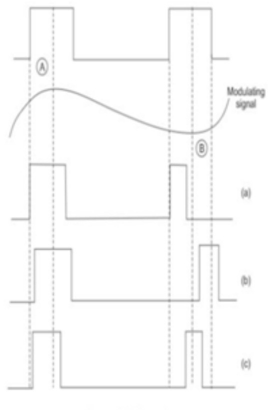


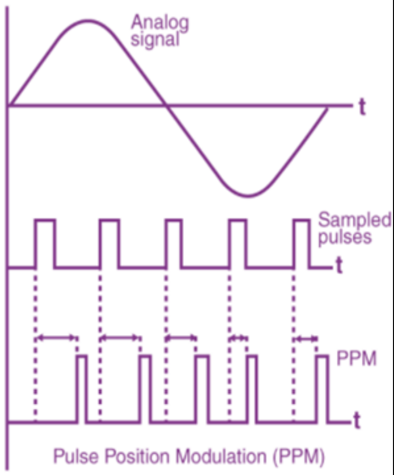
Fig. 6.8 PWM waveforms

Disadvantage

❑Pulses are of varying width and hence of varying power content.

❑The transmitter must be powerful to handle the maximum width pulses

Pulse Position Modulation (PPM)

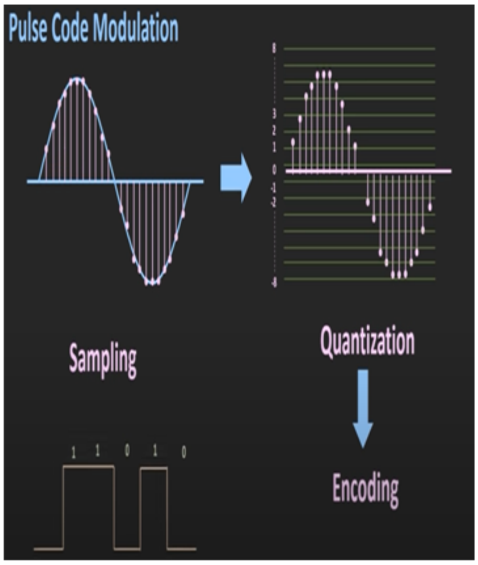


❑Amplitude and width of the pulses are constant but the position of each pulse in relation to the position of the reference pulse is varied according to the instantaneous sampled value of the modulating signal

❑Compared to PWM, PPM has an advantage of requiring constant transmitting power output

❑Disadvantage of depending upon transmitter receiver synchronization

Pulse Code Modulation(PCM)



❑A digital process in which the message is sampled and rounded off to the nearest value of a finite set of allowable values

❑The rounded off values are coded

❑PCM generator produces a series of numbers or digits

❑Each of these digits in binary code represents the amplitude of the signal sample at that instant.

❑Signals are transmitted as binary code