| | S J P N Trust's<br>HirasugarInstitute of Technology, Nidasoshi.<br>*Inculcating Values, Promoting Prosperity*<br>Approved by AICTE, Recognized by Govt. of Karnataka and Affiliated to VTU Belagavi. | ECE Dept.<br>Exam.<br>Internal Assessment<br>Even Sem(2017-18) |
|---|---|---|

# FIRST INTERNAL ASSESSMENT

**Sem : IV** | **Sub: Principles of Communication Systems** | **Sub. Code: 15EC45**

**Date:07/03/2018** | **Time: 11:00AM-12.00PM** | **Max. Marks: 25**

***Note: Answer two full questions, draw sketches wherever necessary.***

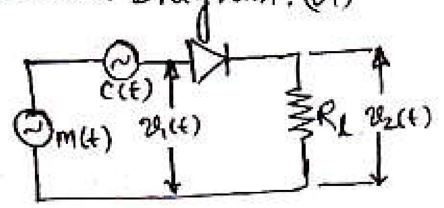
| Q. No | | Discription of Question | Marks | CO | RBT LEVEL |
|---|---|---|---|---|---|
| 1 | a | Explain the operation of the switching modulator with circuit diagram, and waveforms. | 6 | CO213. 1 | L2 |
| | b | Consider a message signal m(t)=20cos(2πt) volts and a carrier signal is c(t)=50cos(100πt) volts.<br>i) Sketch to scale resulting AM wave for 75% modulation<br>ii) Find the power delivered across a load of 100Ω due to this AM wave | 7 | CO213. 1 | L3 |
| OR | | | | | |
| 2 | a | Explain the operation of coherent detection of DSB-SC modulating wave and show that the overall output $v_0(t) = \frac{A_c}{2}\cos(\varphi)\, m(t)_c$ | 6 | CO213. 1 | L2 |
| | b | A 250W carrier of 1000KHz is simultaneously modulated by signals of 2KHz, 6KHz and 8KHz with modulation indices of 35%, 55%, and 75% respectively. What are the frequencies present in the modulated wave and what is radiated power? | 7 | CO213. 1 | L3 |
| 3 | a | With relevant diagrams, explain the operation of the quadrature carrier multiplexing transmitter scheme and receiver scheme. | 6 | CO213. 1 | L2 |
| | b | The amplitude of a sinusoidal carrier is modulated by a single sinusoid to obtain the amplitude modulated signal s(t)=5cos(1600πt) + 20cos(1800πt) – 5cos(2000πt). Find:<br>i) Caarrier and Sideband Frequencies<br>ii) Modulation Index | 6 | CO213. 1 | L3 |
| OR | | | | | |
| 4 | a | Explain the concept of coherent detection. How it is incorporated in the COSTAS receiver? | 6 | CO213. 1 | L2 |
| | b | Consider a message signal m(t) containing frequency components at 100Hz, 200Hz, and 400Hz. This signal is applied to an SSB modulator together with a carrier at 100KHzwith only the USB is retained. In the coherent detector used to recover m(t) the local oscillator supplies a sine wave of 100.02KHz.<br>i) Determine the frequency components of the detector output<br>ii) Repeat the analysis assuming that the only LSB is transmitted. | 6 | CO213. 1 | L3 |

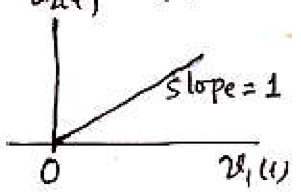
**Course Coordinator** | **Module Cooerdinator** | **HOD**

# SCHEME OF EVALUATION

| Sem : IV | Subject : Principles of Commn Systems | Sub Code : 15EC45 | Date : 07/03/2018 | | |
|---|---|---|---|---|---|
| **Q. No.** | **Bit** | **Description** | **Marks** | **CO's** | **RBT LEVEL** |
| 1 | a | Circuit Diagram: (01) | 06 | CO213.1 | L2 |
| | (b) | $m(t) = 20\cos(2\pi t)$ $c(t) = 50\cos(100\pi t)$ | 07 | CO213.1 | L3 |

**1 a** Circuit Diagram: (01)



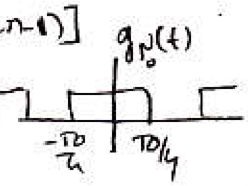

$$v_1(t) = A_c\cos(2\pi f_c t) + m(t) \quad (03)$$

$$v_2(t) = \begin{cases} v_1(t) & c(t) > 0 \\ 0 & c(t) < 0 \end{cases}$$

$$\Rightarrow v_2(t) \simeq [A_c\cos 2\pi f_c t + m(t)]\, g_{T_0}(t)$$

$$g_{T_0}(t) = \frac{1}{2} + \frac{2}{\pi}\sum_{n=1}^{\infty}\frac{(-1)^{n-1}}{2n-1}\cos 2\pi f_c t(2n-1)]$$

$$\Rightarrow \frac{A_c}{2}\left[1 + \frac{4}{\pi A_c}m(t)\right]\cos 2\pi f_c t$$

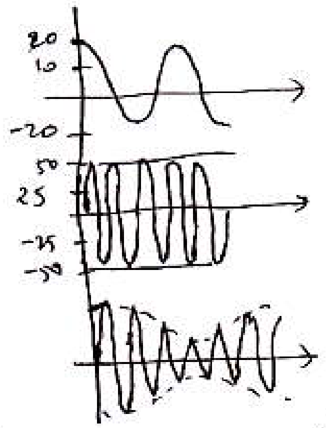




Circuit diagram: 01, wavefor(01) chars (01)
Expression (03)

**(b)** $m(t) = 20\cos(2\pi t)$ $c(t) = 50\cos(100\pi t)$

$A_m = 20$ $A_c = 50$




$$V_m = \frac{V_{max} - V_{min}}{2}$$

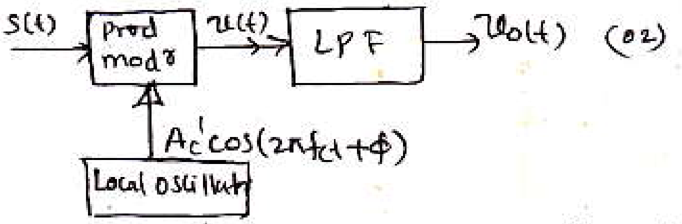
$$V_c = \frac{V_{max} + V_{min}}{2}$$

$$\frac{V_{max} - V_{min}}{V_{max} + V_{min}} = 0.75$$

b) $P_t = P_c(1 + \frac{m^2}{2}) = \frac{50^2}{2\times 100}\left(1 + \frac{(0.75)^2}{2}\right) = 16.01W$

# SCHEME OF EVALUATION

| Sem : IV | Subject : | Sub Code : | Date : | | |
|---|---|---|---|---|---|

| Q. No. | Bit | Description | Marks | CO's | RBT LEVEL |
|---|---|---|---|---|---|
| 02 | (a) |  (02) | 06 | C213.1 | L2 |



coherent detection of DSB-SC Signal

$v(t) = A_c' \cos(2\pi f_c t+\phi) \cdot s(t)$ (03)

$\Rightarrow A_c A_c' \cos(2\pi f_c t) \cos(2\pi f_c t+\phi) m(t)$

$= \frac{1}{2} A_c A_c' \cos(4\pi f_c t+\phi) m(t) + \frac{1}{2} A_c A_c' \cos\phi\, m(t)$

After LPF, neglecting high frequencies

$\Rightarrow v_o(t) =$ ~~$\cos(2\pi f_c t)$~~ $\frac{1}{2} A_c A_c' \cos\phi \cdot m(t)$

$v_o \rightarrow$ max for $\phi = 0$. & $v_o = 0$ for $\phi = 90°$

$v_o = 0 \rightarrow$ quadrature null

Explaination : 01

| Q. No. | Bit | Description | Marks | CO's | RBT LEVEL |
|---|---|---|---|---|---|
| | (b) | see below | 07 | C213.1 | L3 |

$P_c = 250\,W$, $f_c = 1000 \times 10^3\, Hz$

$f_{m1} = 2\,KHz$, $f_{m2} = 6\,KHz$, $f_{m3} = 8\,KHz$

$\mu_1 = 0.35$, $\mu_2 = 0.55$ & $\mu_3 = 0.75$

$\mu_t = \sqrt{(0.35)^2 + (0.55)^2 + (0.75)^2} = 0.9937$ (03)

$P_t = 250 \left[1 + \frac{\mu_t^2}{2}\right] = 373.43\,W$

$f_{USB} = f_c + f_{m1} = 1000K + 2KHz = 1002\,KHz$

$f_c + f_{m2} = 1000K + 6KHz = 1006\,KHz$

$f_c + f_{m3} = 1000K + 8KHz = 1008\,KHz$

$f_{LSB} = f_c - f_{m1} = 1000K - 2K = 998\,KHz$

$f_c - f_{m2} = 1000K - 6K = 994\,KHz$

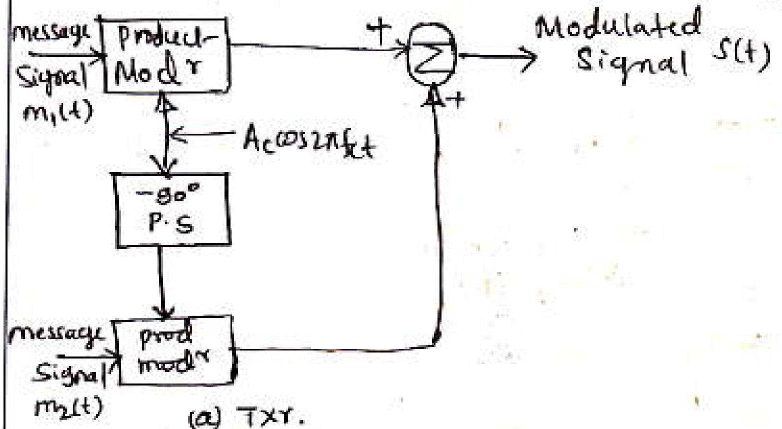
$f_c - f_{m3} = 1000K - 8K = 992\,KHz$ (04)

& $f_c = 1000\,KHz$

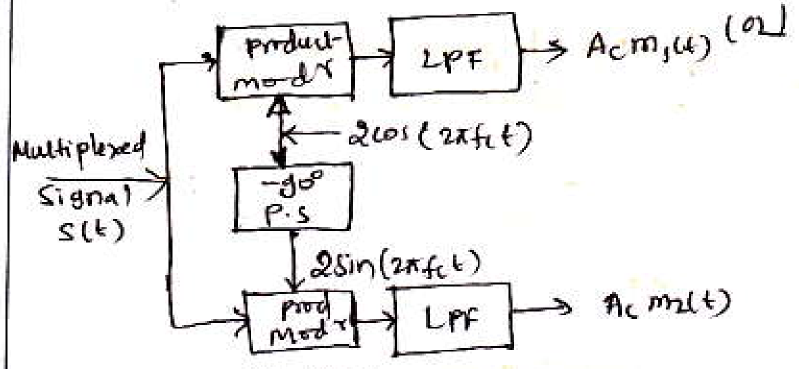
Staff-in-Charge   Module Coordinator   HOD

# SCHEME OF EVALUATION

| Sem : IV | Subject : principles of communication System | Sub Code : 15EC45 | Date : 07/03/2018 | | |
| --- | --- | --- | --- | --- | --- |
| **Q. No.** | **Bit** | **Description** | **Marks** | **CO's** | **RBT LEVEL** |
| 3 | (a) | Transmitter (02) | 06 | C0213.1 | L2 |




(a) TXr.




(b) RXr.

(02)

→ Scheme is QAM
→ two independent modulating signals can be multiplexed using one carrier with Quad. P.
→ Similarly can be demuxed & extracted.

(b) i) $s(t) = 20\cos(2\pi \times 900t) + 5\cos(2\pi(900+100)t)$ $+ 5\cos(2\pi(900-100)t)$ — 06

$\Rightarrow f_c = 900\text{Hz} \quad f_m = 100\text{Hz}$ (03)

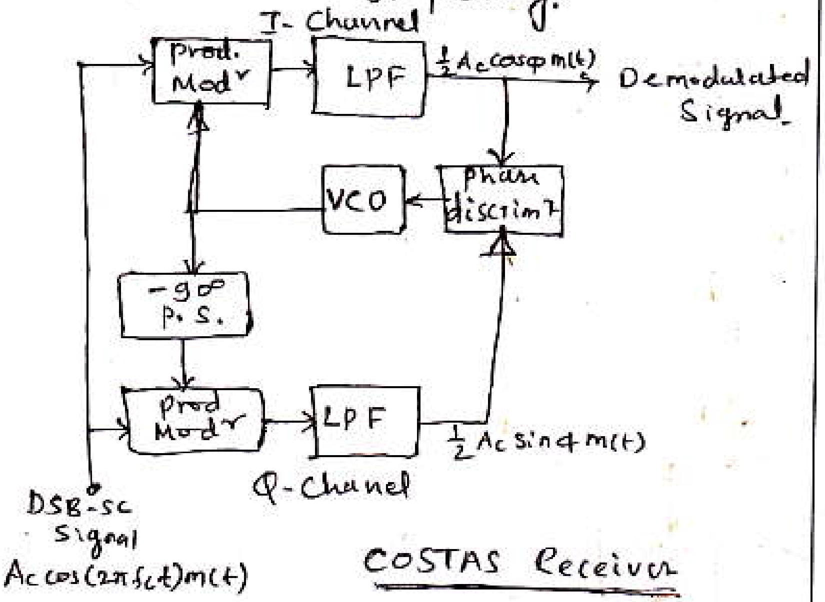
$f_{LSB} = 900-100 = 800\text{Hz}$ & $f_{USB} = 1000\text{Hz}$

ii) $\frac{\mu A_c}{2} = 5 \Rightarrow \mu = \frac{10}{A_c} = \frac{10}{20} = 0.5$ (03)

Staff-In-Charge Module Coordinator HOD

# SCHEME OF EVALUATION

| Sem : IV | Subject : principles of communication Syst. | Sub Code : 15EC45 | Date : 07/03/2018 | | |
|---|---|---|---|---|---|
| **Q. No.** | **Bit** | **Description** | **Marks** | **CO's** | **RBT LEVEL** |
| 4 | (a) | Coherent detection assumes that locally generated carrier is of same freq & phase as that of transmitter carrier frequency. | 06 | CO213.1 | L2 |




COSTAS Receiver

⟹ Circuit has two sections I-Channel & Q-Channel
- two overcome the effect of 'quadrature null' effect I-Channel (in-phase) $\phi = 0$ & Q-channel (Quad-channel $\phi = 90$) are used.
- any change in the phase (i.e., phase shift can be tracked and detected with feed back loop

**(b)** — Marks: 06, CO's: CO213.1, RBT Level: L3

$m(t) \rightarrow f_{m_1} = 100\text{Hz},\ f_{m_2} = 200\text{Hz}, \text{ and } f_{m_3} = 400\text{Hz}$

$f_c = 100\text{kHz}$

$f_{USB} = 100K + 0.1K,\ 100K + 0.2K,\ 100K + 0.4K$

Detector components (Assuming LPF is connected) $(f_c + f_m) - f_c'$

$= 100K + 0.1K - 100.02K \Rightarrow 0.08K$ (80Hz)

180Hz & 380Hz

||ly LSB ⟹ Same results i.e, $f_c' - (f_c - f_m)$

80Hz, 180Hz and 380Hz