

M.Sc. Examination, 2019
Semester-IV
Physics
Special Paper: MPC-461
(Electronics-III)

Time: Three Hours

Full Marks: 40

Questions are of value as indicated in the margin.
Answer *any four* questions.

1. What is a 'Klystron'?
Explain, with necessary diagram, the roles of buncher and catcher cavities leading to microwave amplification.
Derive an expression for velocity modulation of the electrons in a Klystron.
The values of the parameters for a Klystron amplifier are given below:
DC voltage: 200 volts, signal frequency = 2 GHz, Buncher cavity gap width = 2mm.
Calculate the value of the beam coupling coefficient. 1+4+3+2

2. A center-fed half wave dipole antenna is fed by a high frequency sinusoidal current. Show the current distribution over the length of the antenna.
Derive an expression for the magnetic field in the far field radiation of the above antenna, assuming the radiation taking place in free space.
What is 'Radiation resistance' of an antenna? 2+6+2

3. A DSB+C AM signal is accompanied by band-limited white noise and it is detected by an envelope detector.
Calculate the ratio of SNR output to SNR input where 'SNR' stands for signal-to-noise power ratio. Assume the noise level at the input to be much less than the input signal level for your calculation.
A DSB+C AM signal with an AM index of 0.5 is accompanied by band-limited white noise. Calculate the value of $(SNR)_{output}/(SNR)_{input}$.
If the above said signal is detected in a synchronous detector in the same environment, calculate the ratio $(SNR)_{output}/(SNR)_{input}$ under the condition of small noise. 5+2+3

4. What is a 'Magnetron'?
Explain physically how microwave oscillation is generated in a magnetron.
A cylindrical magnetron has a cathode radius of 5 cms. and the anode radius of 10 cms. as measured from the center of the cathode. The cut-off magnetic field is 4 milliWeber/m². Calculate the dc anode voltage of the magnetron. 1+6+3

5. What do you mean by 'Nyquist rate'?
Discuss the operation of different stages involved in the generation of PCM signal.
A band-limited message signal has a bandwidth of 3.2 kHz. What is the Nyquist rate for sampling? If the sampling is done at a rate 10% higher than the Nyquist rate, what will be the sampling rate? 2+6+2

P.T.O.

6. What do you mean by IM-DD optical communication system?
Explain with necessary block diagram a simple scheme of IM-DD communication system.
The L-I characteristics of a Fabry-Perot semiconductor laser has a slope of 0.2mW/mA. The threshold current of the laser diode is 41.6 mA and the dc bias current is 51.6 mA. The LD is directly modulated by a current $\sin(2\pi \cdot 10^6 t)$ mA current drive. Calculate the operating point LD power output.
Find out the IM index of the LD output. 1½+5½+3
7. Write notes on *any two* of the following: 5+5
- i) TWT
 - ii) Broad side array of half-wave dipole antennas
 - iii) Noise immunity of FM over AM
 - iv) OOK, FSK and PSK signals.
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