Reg. No. | | | | | | | | | | |

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

(A constituent unit of MAHE, Manipal)

SEVENTH SEMESTER B.TECH. (INSTRUMENTATION AND CONTROL ENGG.)

END SEMESTER DEGREE EXAMINATIONS, MARCH - 2021

SUBJECT: ANALYTICAL AND OPTICAL INSTRUMENTATION [ICE 4101]

TIME: 3 HOURS 17-03-2021 MAX. MARKS: 50

Instructions to candidates :*Answer ALL questions and missing data may be suitably assumed.*

1A. What would be the numerical aperture of an objective lens when in air, water and oil. Assume that the fluids form a cubical interface of dimensions 1.2 mm with the lens. Assume RI of air, water and oil as 1, 1.33 and 1.57. How would you correlate numerical aperture and resolution in micro-imaging systems?

1B. The secondary emission factor of each of seven dynodes of a PMT is 7. If 3 photons are incident on this PMT, calculate the number of photons seen at the detector. If the detector is just saturated with this output and a spectrophotometric measurement leading to a binding event measured as an increase in absorbance to an OD of 1.2, determine the number of counts (output Intensity) observed for a 12 bit ADC.

1C. Explain the various sources, filters and detectors in UV, Visible and IR spectroscopy.

(2+3+5)

2A Draw and infer the H^1 NMR spectrum of the sample CH_3-CH_2-CHBr-CH_3.

2B With neat diagrams, explain the process of data transfer in a CMOS and CCD photodetectors. Compare the role of blooming and rolling shutter effects in the two detectors.

2C Differentiate between gel permeation chromatography and ion exchange chromatography.

(2+4+4)

3A Discuss on the significance of pumping in lasing action and describe the advantages and disadvantages of 4 level lasers over 3 level lasers.

3B Explain the theory, principle and working of NMR spectroscopes. Draw and analyse the NMR spectrum if the sample has alkyl chloride in it.

3C Compare the working of radio frequency mass spectrometers with magnetic deflection type mass spectrometers. Explain the importance of reflectrons in mass spectrometers.

(2+4+4)

4A What is the effect of division of wavelength and division of amplitude of the signals in interferometric analysis?

4B Compare Michelson's interferometer with fabrey perot interferometer. Discuss whether there is any correlation between interferometry and holography?

4C What is meant by slicing in fibre optic communication? Explain the different losses in fibre optics and discuss the various methods to minimise those losses.

(2+3+5)

5A Discuss why hydrogen in the sample can be well detected by thermal conductivity analysers. Which would be the possible carrier gas in Hydrogen thermal conductivity detectors.

5B With the help of schematics explain working of paramagnetic oxygen analyser.

5C Explain different methods for the measurement of Carbon monoxide and Nitrogen oxides in the environment. (2+3+5)

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