All Q's are compulsory

Q.1

(a) What is(are) the essential difference(s) in the functional principle between a FBG and a LPG?

(b) By considering interference between two uv plane waves propagating at an angle 2θ in the xz-plane in a medium of r.i. n_{uv}, obtain the fringe spacing.

(c) If this interferogram is to be used as a Bragg mirror to reflect λ = 1550 nm, what would be the value of θ? Given that λ_{uv} = 244 nm, at which n_{uv} = 1.5.

4+5+4

Q.2

(a) What is(are) the most important feature(s) of surface plasmon mode with respect to a metal-dielectric interface?

(b) Consider a side-polished fiber half-coupler, which has been polished right up to the core so that the core is reduced in size from its original value and the fiber is no longer able to guide any light; why?

(c) If we now load it with a thin metal layer, would the combined structure be able to guide any light? Answer with appropriate arguments.

(d) What would be fractional error in the coupling length (L_c) that could be allowed in a fiber coupler made of SMF-28 type of single-mode fiber so that the loss in the throughput power is > 99%? You may assume that L_c = 10 mm.

3+3+2+5

Q.3

(a) What is the functional principle of a chirped FBG-based dispersion compensator?

(b) Consider a Michelson type of all-fiber interferometer. Draw a schematic diagram and then discuss how such an interferometer could be used to function (i) as a hydrogen gas sensor (ii) as a band pass filter.

(d) Taking the expression for output intensity (as a function of the phase difference) for either of the arms of an all-fiber MZI, explain how such an interferometer could be exploited to as an instrument to detect sound.

(e) It is given that the sensing arm of the MZI has a sensitivity of 5×10^{-4} rad/Pa/m and its length is 100 m. If the threshold of hearing is 2×10^{-5} Pa, what would be phase retardance induced by a sound wave at this level if incident on the sensing arm of the MZI?

3+6+3+3

Q.4

(a) Through appropriate algebra, discuss functional principle of a fiber loop mirror and hence argue how such a loop mirror could be used as optical switch?

(b) Just draw a schematic diagram (labeling each component/item in its layout) to depict use of such a loop mirror as a gyroscope or rotation sensor.

(c) If 500 m of a SMF is coiled on a spool of radius 10 cm, what would be the phase difference between the cw and ccw propagating beams corresponding to earth's rotation i.e. 15^0/hr. Assume λ_0 = 633 nm.

4+3+2