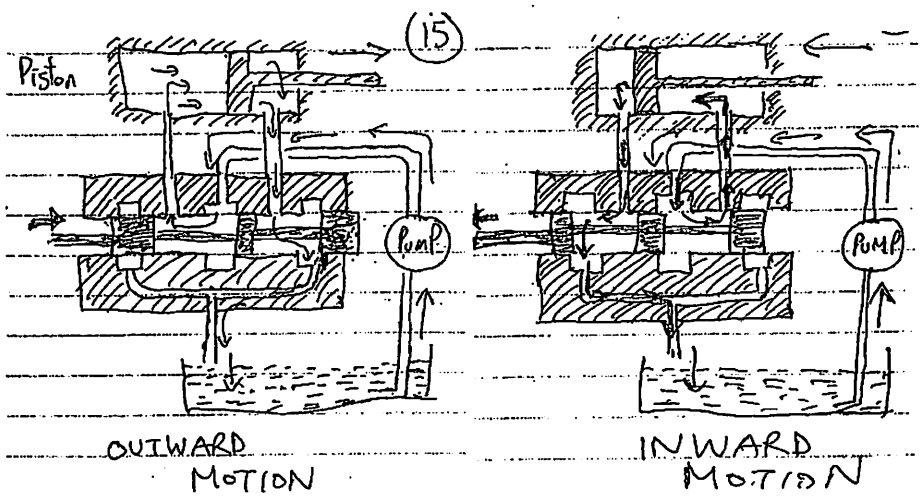
DEPARTMENT OF ELECTRICAL ENGINEERING

SOLUTION & MARKING SCHEME

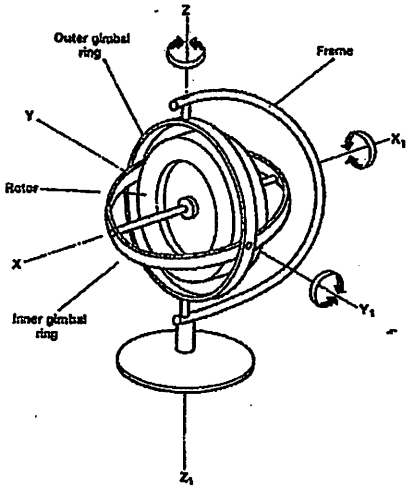
(Semester 1, 2013/14)

SUBJECT (Code & Title) : EE539 Aerospace Power Electronics and Actuation Systems

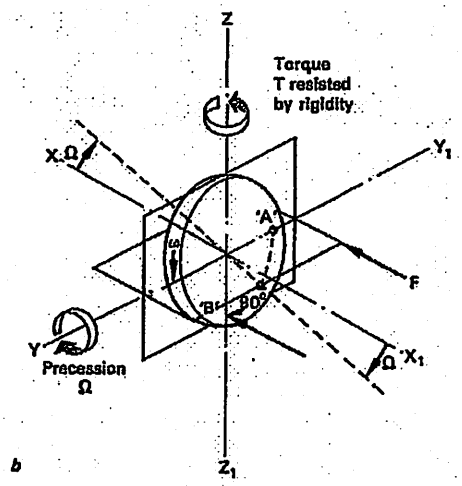
SUBJECT EXAMINER	K.W.Cheng, K.W.Chan, N.C.Cheung
INTERNAL MODERATOR	S.L. Ho

QUESTION NO. ( )	SOLUTION	MARKS
1. (a)	(i) Pump failure: loss of hydraulic pressure >> hydraulic fluid remains static and no circulation >> the force output on the piston will go down on the whole hydraulic system But there are two independent pump systems>> It will continue to move the flap. (ii) Servo valve control failure: Three scenarios: either the valve will go full right, full left, or no response. Full right: it will cause the valve to go full right and hydraulic piston to travel to one extreme, which is outside the controllable range of the servo system. Once this is established the safety valve will be released, and the aircraft wing will be controlled by the other hydraulic system. Full left: it will cause the valve to go full left and hydraulic piston to travel to another extreme, which is outside the controllable range of the servo system. Once this is established the safety valve will be released, and the aircraft wing will be controlled by the other hydraulic system. No response. This happens when the control valve is stuck. Since there is no control, the piston will slowly go to one extreme. When this happens, the safety valve will be released, and the aircraft wing will be controlled by the other hydraulic system. (iii) Hydraulic fluid leakage will cause the oil pressure to slowly drop to zero. There will be no force on the piston cylinder. The other independent hydraulic system will take over the job.	10
(b)	 Add some explanation	10

QUESTION NO. ( )	SOLUTION	MARKS
2. a)	Structure and operating principle	4



Free Gyroscope (FG)



Rate Gyroscope (RG)

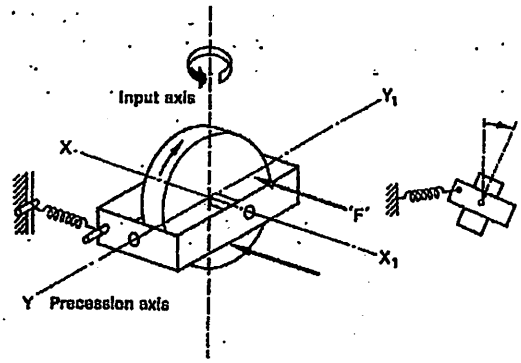
FG: Use Rigidity Principle: this property resists any force to change the plane of rotation of gyroscope.

RG: the angular rate of change in the plane of rotation of the gyroscope is proportional to the strength of the output force on a perpendicular plane

Sensing parameter interfacing technique:

FG: Use rotary position sensors for 3 axes (X-Y-Z)

RG: Sense for one axis only (X). Y axis must be spring loaded. Z is the spinning axis. 4



Application in aircraft:

FG: For slow steady reading on the X,Y,Z angles.

RG: For fast dynamic motions (angle & rate of change of angle). Need 3 RGs for the 3 axes. 2