Total number of printed pages–6

53 (IE 711) FPCN

2021

(Held in 2022)

FLUIDIC POWER AND CONTROL

Paper : IE 711

Full Marks : 100

Time : Three hours

The figures in the margin indicate full marks for the questions.

*Answer **any five** questions.*

1. *(a)* Draw a neat diagram of a basic hydraulic system and explain the functions of—

   (i) Directional control valve ;

   (ii) pressure relief valve;

   (iii) cylinder ; and

   (iv) check valve. 4+4=8

Contd.

(b) Which desirable functions are possessed by air for its popular use as process fluid? What are the disadvantages of using air in fluid power control system? 2+2=4

(c) What are the primary functions of hydraulic fluid ? What types of properties are desired for selecting hydraulic fluid for engine applications? 2+2=4

(d) Define following : 1×4=4

(i) Hydraulic power

(ii) Specific weight

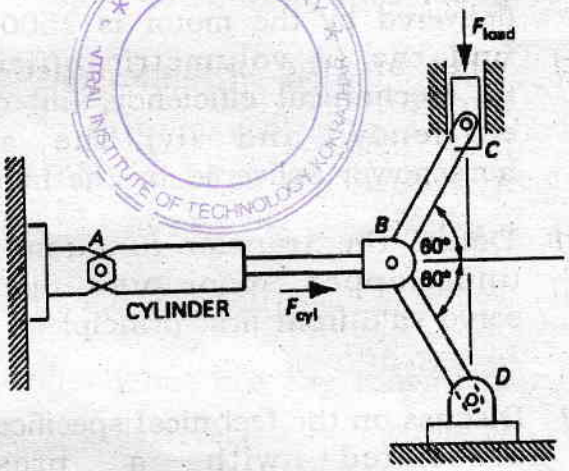
(iii) Specific gravity

(iv) Absolute viscosity

2. (a) Discuss an application of Bernoulli's theorem in automobile engine. 4

(b) A 164 cm^3 sample of oil is compressed in a cylinder until its pressure is increased from 687 *kPa* to 13740 *kPa*. If the bulk modulus equals 1718 *Mpa*, find the percentage change in volume of oil. 6

(c) For the toggle mechanism, determine the output load force (F load) for a hydraulic cylinder force of 1000 *lb*. 10



3. (a) Explain the basic design and operation of a vane pump. Give the expression of the volumetric displacement of a vane pump. 6

(b) Describe the working principle of external gear motor and inline piston motor with the help of diagrams. 8

(c) A hydraulic motor has a displacement of 10 in^3 and operates with a pressure of 1000 *psi* and a speed of 2000 rpm. If the actual flow rate consumed by the motor is 95 *gpm* and the actual torque delivered by the motor is 1500 *in.lb*, find the (i) volumetric efficiency, (ii) mechanical efficiency, (iii) overall efficiency, and (iv) the actual horsepower delivered by the motor. 6

4. (a) Derive the transfer function of an underlapped spool pilot operated servo vale from first principles. 12

(b) Discuss on the technical specifications associated with a pressure relief valve for industrial safety. 4

(c) Explain how smart positioner works with control valves. 4

5. (a) Explain the concept of negative and positive feedback on a pneumatic flapper nozzle unit with PID features. 4

(b) What are different types of fluid conditioners required for pneumatic fluid power system ? Briefly explain their roles. 2+6=8

(c) Draw the ANSI symbols of air pressure regulator, pneumatic silencer, 3-way valve and 2-position single solenoid. 4

(d) Determine the actual power required to drive a compressor that delivers 100 *scfm* of air at 100 *psig*. The overall efficiency of the compressor is 75%. 4

6. (a) (i) What are the moving part logic devices ? 2

(ii) How can they be actuated ? 2

(b) Implement AND and OR gate operation-using two-way two-position spring loaded valves. 2+2=4

(c) (i) Draw an SR flip-flop with NOR gates. 2

(ii) Explain about its memory functionality. 2

(d) Discuss the working of a two-handed press control system with necessary diagram. 8

7. (a) Explain the following terms for an electrohydraulic servo system : 10

(i) System accuracy

(ii) Open loop gain

(iii) Tracking erro

(iv) Dead band

(v) Hysteresis

(b) Explain with a neat diagram the refrigerated dryer cycle for conditioning the outlet of compressed air. 10