EAST AFRICAN SCHOOL OF AVIATION EXAMINATION

END TERM II EXAMS

DIPLOMA IN AURONAUTICAL ENGINEERING TELECOMMUNICATION

PHYSICAL SCIENCE, MECHANICAL SCIENCE & ELECTRICAL PRINCIPLES

STREAM: Y1 (Telecommunication)                  Duration: 3 HRS

DATE: 11.4.2017                                  TIME: 0900 – 1200 HRS

INSTRUCTION TO CANDIDATES

1. This paper consists of FOUR (4) pages
2. You should have the following for this examination:
   
   Mathematical tables/ Electronic calculator.

3. Answer ALL questions in section 1, ANY 2 questions in section 2 and ALL in section 3.
SECTION 1: PHYSICAL SCIENCE

Answer **ALL** questions from this section

1. a) State Newton’s law of cooling. **(2 marks)**
   
b) Explain three modes of heat transfer. **(3 marks)**
   
c) Distinguish between the following terms.
   
i) Adiabatic process and isothermal process
   ii) Closed system and open system
   iii) Isochoric process and isobaric process
   iv) Boundary and surrounding of a system. **(8 marks)**
   
d) A quantity of air is compressed in a cylinder to one-fifth of its original volume. The pressure is initially 13 bar and the temperature during compression rises from 18°C to 130° C.
   
i) Calculate the pressure of the compressed air. **(5 marks)**
   
ii) If this air is allowed to expand at constant temperature to its original volume, calculate the new pressure. **(5 marks)**
   
e) State **TWO** conditions for simple harmonic motion. **(2 marks)**

SECTION 2: MECHANICAL SCIENCE

Answer any **TWO** questions from this section

2. a) Explain any **FOUR** non-destructive testing methods used in materials. **(4 marks)**
   
b) Explain the following terms as used in materials
   
i. Malleability
   
ii. Hardness
   
iii. Corrosion
   
iv. Elasticity **(8 marks)**
   
c) An object of mass 2 kg slides from rest down a smooth plane inclined at 30° to the horizontal. What will be its velocity when it has slid 2 m down the plane. **(4 marks)**
   
d) The resistance to motion of a car is proportional to the square of its speed. The car has a mass of 1000 kg and can maintain a steady speed of 30 m/s when travelling up a hill inclined at arcsin $\frac{1}{20}$ to the horizontal with the engine working at 60 kW. Find the acceleration of the car when it is travelling down the same hill with the engine working at 4 kW at the instant when the speed is 20 m/s. **(4 marks)**
3. a) Define the following terms as used in fluid flow.
   i) Laminar flow
   ii) Turbulent flow
   iii) Pressure head
   iv) Discharge

   (4 marks)

b) Name THREE instruments used to measure fluid pressure.

   (3 marks)

c) Water is flowing through a pipe having diameters 20 cm and 10 cm at sections 1 and 2 respectively. The rate of flow through the pipe is 35 litres/s. The section 1 is 6 m above datum and section 2 is 4 m above datum. If the pressure at section 1 is 39.24 N/cm², find the intensity of pressure at section 2.

   (13 marks)

4. a) State the first law of thermodynamics.

   (2 marks)

b) An unmarked thermometer is put in ice-water mixture (at 0°C) and boiling water. The length of liquid column is 2.6 cm and 8.4 cm respectively. If the length of the liquid column becomes 12 cm when put into hot oil, determine the temperature of the hot oil.

   (4 marks)

c) Define the following terms as applied in heat.
   i) Heat capacity
   ii) Specific latent heat of fusion
   iii) Isolated system.

   (6 marks)

d) Show that \( c_p - c_v = R \) where \( c_p \) - specific heat capacity at constant pressure, \( c_v \) - specific heat capacity at constant volume, \( R \)- specific gas constant

   (8 marks)

SECTION 3: ELECTRICAL PRINCIPLES

Answer ALL questions from this section

5. a) Define the following terms.
   (i) Static electricity
   (ii) Electric intensity
   (iii) Electric displacement
   (iv) Potential difference

   (4 marks)

b) State the three laws of electrostatics

   (3 marks)

c) Three point charges of \(+16 \times 10^{-9} \text{C}\), \(+64 \times 10^{-9} \text{C}\) and \(-48 \times 10^{-9} \text{C}\), are placed at the corners of a square of 4 cm sides. Calculate the electric field at the fourth corner.

   (7 marks)
d) Three concentric spheres of radii 4, 6 and 8 cm have charges of +8, -6 and +4 \mu C respectively. What are the potentials and field strengths at points 2, 5, 7 and 10 cm from the center? (6 marks)

6. a) Define the following as used in S.I units

   i) Mole. (1 mark)
   ii) Ampere. (1 mark)
   iii) Meter. (1 mark)
   iv) Candela. (1 mark)
   v) Unit. (1 mark)

b) Using MKSA system of unit derives the dimensional equations of:

   i) e.m.f; (2 marks)
   ii) Magnetic flux density; (2 marks)
   iii) Capacitance. (2 marks)

c) A gas bubbles from an explosion under water oscillates with a period and proportional to $P^a d^b E^c$ where $P$ is the hydrostatic pressure, $d$ is the density of water and $E$ is the energy of explosion. Find the values of $a$, $b$ and $c$. (9 marks)