TECHNICAL UNIVERSITY OF MOMBASA

Faculty of Engineering and Technology

DEPARTMENT OF MECHANICAL AND AUTOMOTIVE ENGINEERING

DIPLOMA IN MECHANICAL ENGINEERING (PLANT OPTION)
DIPLOMA IN MECHANICAL ENGINEERING (AUTOMOTIVE OPTION)

EME 2102
MECHANICAL SCIENCE I

END OF SEMESTER EXAMINATIONS

SERIES: DECEMBER, 2013

TIME: 2 HOURS

INSTRUCTIONS TO CANDIDATES:

1. You should have the following for this examination:
   - Answer Booklet
   - Scientific Calculator
2. This paper consists of **FIVE** Questions.
3. Answer **ANY THREE** Questions.
4. All Questions carry equal marks.
5. **This paper consists of THREE printed pages.**

Question ONE

(a) State the **THREE** Newtons Laws of Motion. **(8 marks)**

(b) A certain body falls freely from a height of 90m and at the same instant a second body is projected upwards from the ground along the same vertical line, with a velocity of 60m/s. Determine the distance and time when the two bodies meet. **(8 marks)**

(c) A car accelerates uniformly from rest at $1.5m/s^2$ and immediately begins to decelerate to a stop at $1.8m/s^2$. The total distance covered is 2000m:

(i) Find the total time taken
(ii) Find the greatest velocity attained

(9 marks)

Question TWO

(a) State the **THREE** equations of angular motion. **(3 marks)**

(b) The speed of an electric motor rises from 1500 rev/min to 1800rev/min in 2 sec. Calculate:

(i) The average angular acceleration
(ii) Number of revolutions turned through in this time

(8 marks)

(c) A winding drum of mass 120 tonnes has a radius of gyration of 2m.

Determine:

(i) The constant torque required to increase the speed from 30 rev/min to 80 rev/min in 40 seconds if the friction torque is 12KNm.
(ii) If the wheel is rotating freely at 80rev/min and brakes are applied bringing it to rest in 100revolutions, calculate the brake torque assuming uniform retardation.

(9 marks)

Question THREE

(a) (i) Explain what is projectile motion of a body.

(ii) Show that for a projectile on a horizontal plane:

$$H = \frac{U^2 \sin^2 \theta}{2g}$$

Where:	H	-	Maximum height in air
	U	-	Velocity of projection
	Θ	-	Angle of projection
	g	-	Acceleration due to gravity

(7 marks)

(b) A golf ball at rest on the ground is struck so that it starts to move with velocity whose horizontal and vertical components are 3xm/s and xm/s respectively? In its fight the ball rises to a maximum height of 12m. Assuming the ground to be horizontal, calculate:

(i) The value of x
(ii) The horizontal distance travelled by the ball before reaching the ground
(iii) The velocity and direction of projection

(13 marks)

Question FOUR

(a) (i) Explain simple harmonic motion (SHM)?

(ii) For a spring-mass system having SHM, show that:

$$T_p = 2\pi\sqrt{m/s}$$

Where:	Tp	=	Periodic time
	m	=	Mass carried by the spring
	s	=	Spring stiffness

(10 marks)

(b) A body moves in SHM. Its velocity had this values 4m/s and 3m/s when its distances from the mean position 2m and 3m respectively.

Calculate:

(i) The amplitude
(ii) The periodic time
(iii) The velocity and acceleration at a displacement of 2.5m from the mean position.

(10 marks)

Question FIVE

In the roof truss of Figure Q.5 the pin joints mid-way along the long sides and joined by a horizontal bar and are connected also to a pinpoint at the midpoint of the horizontal link spanning the points of support. The right hand reaction is vertical. Find:

(i) The magnitude and direction of the support reactions

(ii) The nature and magnitude of the force in each member

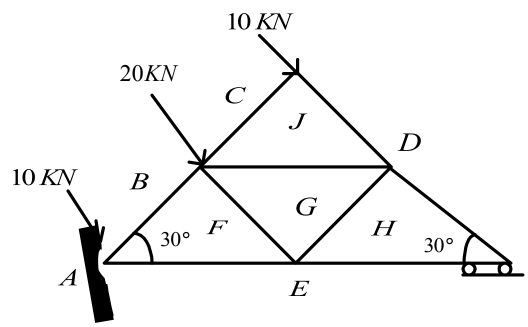

Fig. Q.5

(20 marks)