ROBERT MUGABE SCHOOL OF HERITAGE AND EDUCATION AND CULTURE

DEPARTMENT OF SCIENCE AND TECHNICAL EDUCATION

BACHELOR OF EDUCATION SECONDARY/PRIMARY IN-SERVICE

HONOURS DEGREE

BACHELOR OF EDUCATION SECONDARY PRE-SERVICE HONOURS DEGREE

LEVEL2 SEMESTER 2

LEVEL 2 SEMESTER 1

LEVEL 4 SEMESTER 1

EXAMINATION QUESTION PAPER

MODULE CODE	**CMTS 211/CMTP223/TDSM411**
MODULE NARRATION	**MECHANICS**
DATE	**2025**

DURATION **3 HOURS**

INSTRUCTIONS TO CANDIDATES:

Answer ALL questions in Section A and THREE questions from Section B

Marks are shown in brackets

SECTION A [40marks]

Answer **all** questions.

1. Given vectors **p** =**i**-2**j**+k, **q**=2**i**-**j**-4**k**,find
   (i)A unit vector peperndicular to both **p** and **q** [5]
   (ii) The component of vector **p** in the direction of **q** [5]

2. Triangle ABC has vertices A(2,1,1), B(4,0,-2) and C(-1,12,3), Using the vector product, find the area of ABC. [5]
3. A particle moves along a space curve **r** = x **i** + y **j** + z **k**, defined by $x = e^{-t}\cos t$, $y = e^{-t}\sin t$, $z = e^{-t}$. Find
   (a) its velocity acceleration at any time t. [4]
   (b) the magnitude of the velocity and of the acceleration at t = 0 [4]

4. Particles of mass 400 g and 800 g are connected by a light inextensible string passing over a smooth pulley. Initially both masses hang vertically. 30 cm above the ground. If the system is released from rest, find the greatest height reached above the ground by the 400gmass. [6]

   5(a) State and prove Lamis Theorem [6]

   (b) Two forces of magnitude 40N and 50N act at a point 0. Given that the angle between them is 45^0 find their resultant [6]

SECTION B [60 marks]

Answer any THREE questions

5. (a)Two stones are thrown from the same point at the same time, one vertically upwards with speed 30 ms^{-1} and the other vertically downwards at 30 ms^{-1}. Find how far apart the stones are after 3 seconds. [5]
   (b) State the law of conservation of linear momentum [4]

(c)Two spheres A and B, of masses Mkg and 2M Kg respectively are stationary on a smooth horizontal table. A is then projected towards B with a velocity of ums^{-1} and collides with B and the two particles coalesce

(i) Find the common velocity after the impact [5]

(ii)The lose in kinetic energy during the impact. [6]

6.A particle of mass 0,8 kg is on a rough plane inclined at an angle α to the horizontal, where $\tan \alpha = \frac{5}{12}$. The particle is acted on by an upward force of 4 N parallel to the line of greatest slope of the plane.

(i) Given that the particle is about to move up the plane, calculate the coefficient of friction between the particle and the plane. [6]

(ii) If the force of 4 N is then removed, find the acceleration of the particle down the plane [6]

(b)Take g = 10 ms^{-2}.

A car has a mass of 600 kg and a maximum power of S Watts. The car has a top speed of 40 ms^{-1} on a flat road and a top speed of 24 ms^{-1} on a hill inclined at θ degrees to the horizontal. Where $\sin \theta = 0,2$. Given that the resistance of the car on both roads is F N, where F is constant, find the values of S and F. [4,4]

7(a) A non-uniform beam is of mass 100 kg and length 12 m. X and Y are points on the beam such that AX = 4 m and AY = 7 m. The weight of the beam can be considered to act at point X. The beam has its lower end A resting on rough horizontal ground and is kept in equilibrium by a rope attached to point Y and making an angle of 55^0 with YA.

Find

(i) the tension in the rope. [5]

(ii) The horizontal and vertical components of the reaction at A. [5]

(b) A bead of mass Mkg is threaded to a string whose ends are attached to a beam. The string makes angles of 60^0 and 30 with the vertical. The system hangs freely under gravity. Find the tensions in the two portions of the strings [5,5]

8 (a) An aircraft at a height of 180 m above the ground and flying horizontally with a speed of 70 ms^{-1}, releases emergency supplies. If the supplies are to land at a specific point on the ground, find at what horizontal distance from this point the aircraft should release the supplies.
[6]

(b) A projectile is fired with initial speed Vm/s at elevation θ from a point O on level ground. Find in terms of V and θ :

(i) The maximum height reached [3]

(ii) Time of flight [3]

(iii)Speed after t seconds [4]

(iv) Equation of path P(x,y) [4]

9.A truck of mass 4000 Kg moves on a horizontal road with engine working at a constant rate of 2000W.

(i) Find the resistance to the motion when it is travelling at its maximum speed of $10ms^{-1}$. [5]

(ii) Calculate the acceleration of the truck if it is travelling at $15ms^{-1}$ [5].

(iii) The truck now ascends a hill inclined at $\sin^{-1}(\frac{1}{10})$. Find its maximum speed. [10]

END OF PAPER