PURWANCHAL UNIVERSITY
II SEMESTER FINAL EXAMINATION-2002

LEVEL : B. E. (Civil.)
SUBJECT: BEG157CI, Applied Mechanics-II (Dynamics)
Full Marks: 80
TIME: 03:00 hrs **Pass marks:** 32

Candidates are required to give their answers in their own words as far as practicable.
The figure in the margin indicates full marks.
Attempt any FIVE questions.

Q. [1] **[a]** Derive the formulae for velocity and acceleration of a particle in radial and transverse component system when the particle is moving along a curvilinear path. [8]

[b] The acceleration of a particle s defined by the relation $a = kv^{2.5}$, where k is constant. The particle starts at x =0 with a velocity 16m/s, and when x = 6m the velocity is observed to be 4m/s.

Determine: **[10]**

[i] The velocity of the particle when x = 5m.

[ii] The time at which the velocity of the particle is 9m/s.

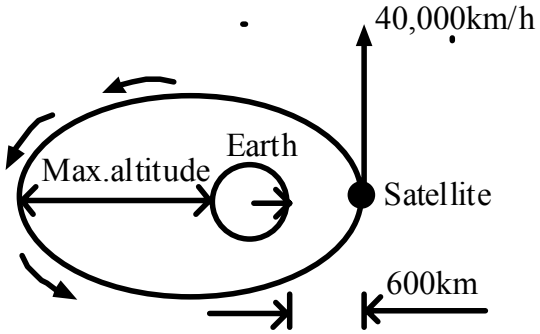
Q. [2] **[a]** What do you understand by 'Dynamic Equilibrium? What are the possible equations of motion for particle moving in curvilinear path? [6]

[b] A satellite is launched in a parallel to the surface of earth as shown fig 2[b] with velocity of 40,000 km/h form an altitude 600 km.

Determine:

[i] The maximum altitude reached by the satellite,

[ii] The periodic time of the satellite. [10]



[R = 6370 km]

Fig. 2[b]

Q. [3] **[a]** Explain about the principle of impulse and momentum , conversion of linear momentum and impulsive motion of particles. [6]

[b[The 3kg slider is released form rest at point 'A' and slides with negligible friction in vertical plane along the circular rod show in Fig 3[b]. The attached spring has stiffness of 350N/m and has an unstreched length of 0.6m. Determine the velocity of slider as it passes position B. Assume necessary data if required. [10]

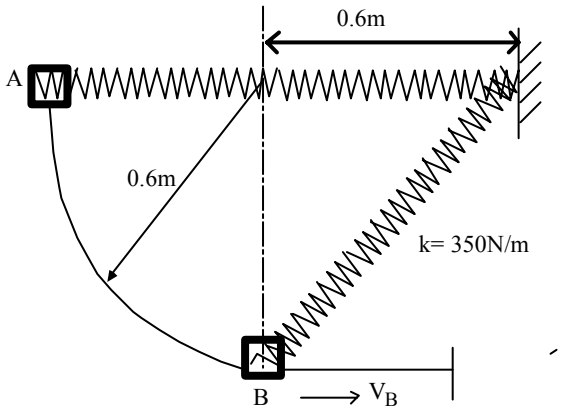


Fig. 3[b]

Q. [4] **[a]** Determine mass center of system of particle. Show that angular momentum $\overrightarrow{H_G}$ of system of particle about the mass center 'G' is equal to the absolute angular momentum $\overrightarrow{H_G}$ of the system with respect to the Newtonian frame of reference.

[b] A 30kg projectile when passing through O with velocity $\overrightarrow{V_o} = (20\text{m/s})\,\hat{i}$ explodes into two fragment A and B, of mass 12kg respectively knowing that 3s later the position of fragment A (300m, 24m, -48m), determine the position of …….fragment at the same instant. Assume a $a_y = -g = -9.8$ m/s^2 and neglect air resistance. [10]

Q. [5] **[a]** What do you understand by instantaneous centre of rotation in general plane motion of a rigid body. Explain the methods to find the instantaneous center in general plane motion.

[b] Load B is connected to a double pulley by one of the inextensible cables as shown in fig. 5[b]. The motion of the pulley is controlled by cable which has a constant acceleration of 225mm/…. and an initial velocity of 300mm/s both directed the right.

Determine:

[i] The number of revolutions executed by he pulley in 2s.

[ii] The velocity and change in position of the load B after 2s.

[iii] The acceleration of point D on the rim the inner pulley at t =0.

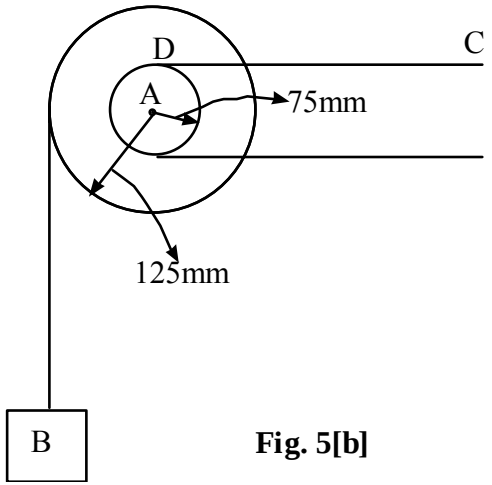


Fig. 5[b]

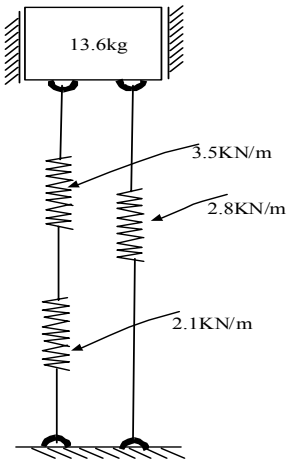
Q. [6] **[a]** Define d Alembert's principle for plane motion of rigid body. What do you understand by constrained plane motion? [6]

[b] A 13.6 kg block is supported by the spring arrangement shown in Fig 6[b] . If the block is moved form its equilibrium position 44mm vertically downward and released.

Determine: **[10]**

[i] The period and frequency of the resulting motion.

[ii] The maximum velocity and acceleration of the block.



PURWANCHAL UNIVERSITY
II SEMESTER FINAL EXAMINATION-2006

LEVEL : B. E. (Civil.)
SUBJECT: BEG157CI, Applied Mechanics-II (Dynamics)
Full Marks: 80
TIME: 03:00 hrs **Pass marks:** 32

Candidates are required to give their answers in their own words as far as practicable.
All question carry equal marks. The marks allotted for each sub-question is specified along its side.
Attempt any FIVE questions.

Q. [1] **[a]** Derive the formulae for velocity and acceleration of a particle in radial and transverse component system, when the particle is moving along a curvilinear path. [6]

[b] Car A and B are d = 60m apart and are traveling at the constant speeds $(V_A)_o$ = 30km/h and $(V_B)_o$ = 24km/h on an ice covered road. Knowing that after the driver of car a applies his brakes to avoid overtaking car B, the two car collide; determine; (i) the uniform deceleration of car A, (ii) the relative velocity of car A with respect to car B when thev collide. [10]

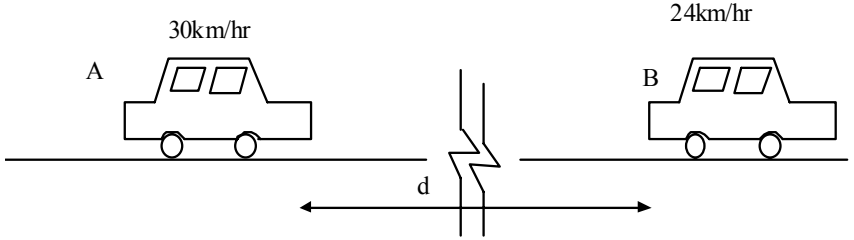


Fig.1 [b]

Q. [2] **[a]** State Newton second law of motion. What do you understand by Dynamic Equilibrium? Write down the dynamic equilibrium equations for in rectangular and tangential and normal components. [6]

[b] A satellite is launched in a direction parallel to the surface of the earth with a velocity of 36,900 km/h form an altitude of 500km and orbits around the earth in an elliptic orbit as shown in the figure. Determine (i) the maximum altitude reached by the satellite, (ii) the periodic time of the satellite. [10]

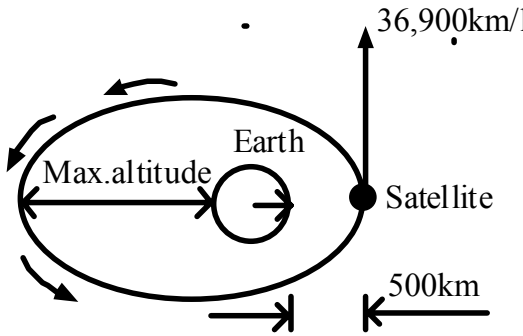


Fig. 2[b]

Q. [3] **[a]** Discuss the principle of work and energy for a particle. Explain the application of the principle with the example of a simple pendulum. [6]

[b] A 600g ball A is moving with a velocity of magnitude 6m/s when it is hit as shown by a 1 kg ball B which has a velocity of magnitude 4m/s . Knowing that the coefficient of restitution is 0.8 and assuming no friction, determine the velocity of each ball after impact. [10]

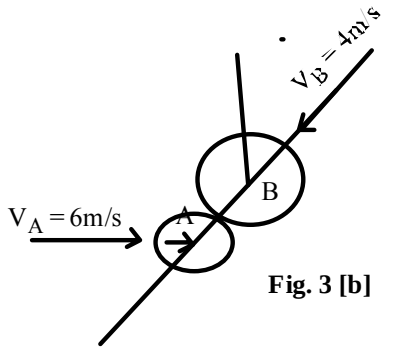


Fig. 3 [b]

Q. [4] **[a]** Obtain the expression for the angular momentum of a system of particles about its mass center. [6]

[b] A 30kg projectile is passing through the origin O with a velocity $\vec{V_0}(120m/s) =$ i when it explodes into two fragments A and B , of mass 12kg and 18kg. respectively. Knowing that 3s later the position of fragment A is (300m, 24m, 048m), determine the position of fragment B at the same instant. Assume $a_y = g = -9.81 m/s^2$ and neglect air resistance. [10]

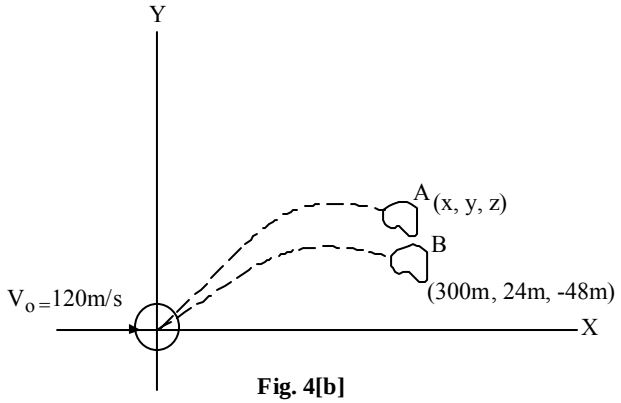
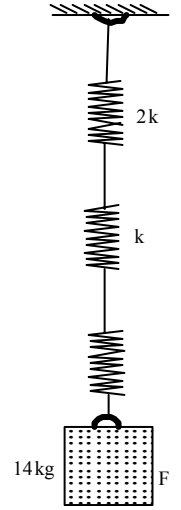


Fig. 4[b]

Q. [5] **[a]** If $\vec{F} = m\vec{a}$ is the equation of motion for kinetics of particles, then write down the equations of motion for the kinetics of a rigid body. State d' Alembert's principle for the plane motion of a rigid body. [6]

[b] A 14kg block is supported , by a the spring arrangement shown. The block is moved form its equilibrium position 20mm vertically downwards and released. Knowing that the period of the result in motion is 1.5s., determine (i) the constant K, (ii) the maximum velocity and the maximum acceleration of the block. 0]



Q. [6] **[a]** Defining the types of rigid body motions write down the expression for uniform and uniformly accelerated rotation of a rigid body about a fixed axis. [6]

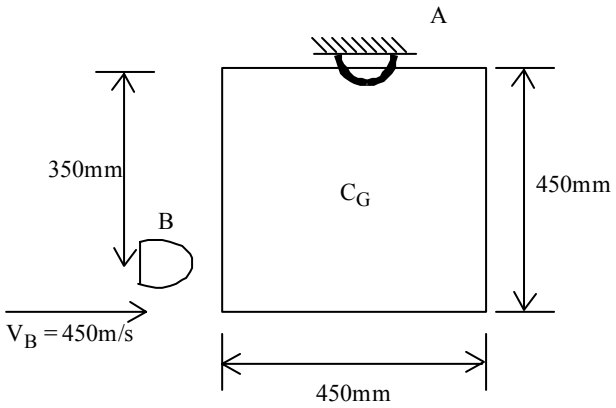
[b] The angular acceleration of a shaft is defined by the relation $\alpha = 0.25W$ where a is expressed in rad/s^2 a and w in rad/s. Knowing that at t =0s the angular velocity of the shaft is 20 rad/s, determine.

(i) the number of revolutions the shaft executes before coming to rest.

(ii) the time required for the angular velocity of the shaft to be reduced to 1% of its initial value. [10]

Q. [7] **[a]** Explain the principle of impulse and momentum for rigid body in plane motion. [6]

[b] A 20k-g bullet B is fired with a horizontal velocity of -450m/s into the side of a 10kg square panel suspended from a hinge at A. Knowing that the panel is initially at rest, determine the angular velocity of the panel immediately after the bullet becomes embedded. [10]



PURWANCHAL UNIVERSITY
II SEMESTER FINAL EXAMINATION-2007

LEVEL : B. E. (Civil.)
SUBJECT: BEG157CI, Applied Mechanics-II (Dynamics)
Full Marks: 80
TIME: 03:00 hrs **Pass marks:** 32

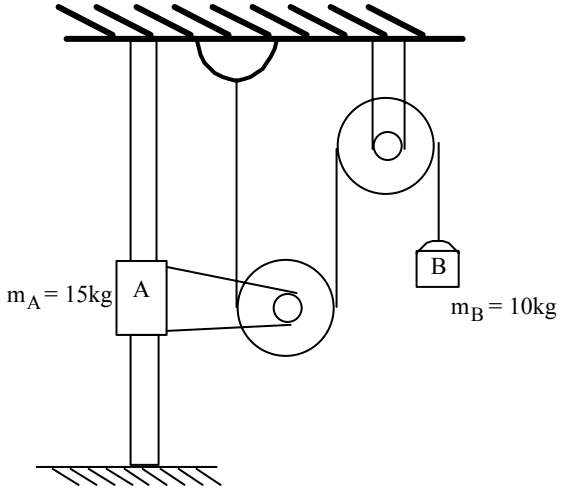
Candidates are required to give their answers in their own words as far as practicable.
All question carry equal marks. The marks allotted for each sub-question is specified along its side.
Attempt any FIVE questions.

Q. [1] **[a]** What are the three types of components of acceleration? Give the relation for acceleration for each of these three types. [2+4]

[b] A particle oscillates between the points x = 40mm and x = 160mm, with an acceleration, a = k(100-x), where k is a constant. The velocity of the particle is 18m/s when x = 100mm and is zero at both x = 40mm and x = 160mm. Determine: [a] the value of k, [b] the velocity when x = 120mm. [6+4]

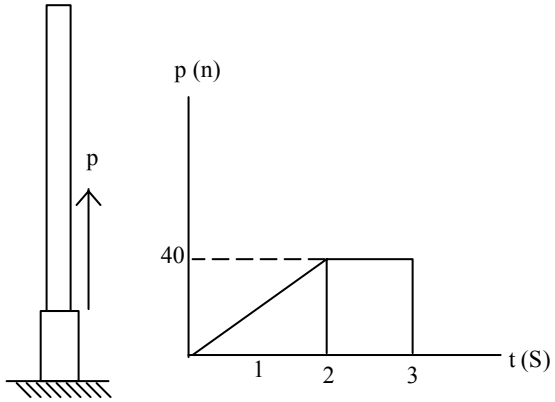
Q. [2] **[a]** What do you mean by linear momentum? Give the basic formula. From this formula, derive the relation for the rate of change of linear momentum. [1+1+4]

[b] The system shown in Fig 2[b] is released from rest. Find the acceleration of the block A. Determine the time it takes for the velocity of A to reach 0.6m/s. Neglect friction and the mass of the pulley. [6+4]



Q. [3] **[a]** Derive the relation for the velocities after direct central impact. [6]

[b] A 2 kg collar which can slide on a frictionless vertical rod is acted upon by a force P which varies in magnitude as shown in Fig 3[b]. Knowing that the collar is initially at rest, determine [a] the maximum velocity of the collar, [b] the time when the velocity is zero. [6+4]



Q. [4] **[a]** Give the relations for linear and angular momentum in a discrete system of particles. From the relations derive the formulae for their rate of change. [2+4]

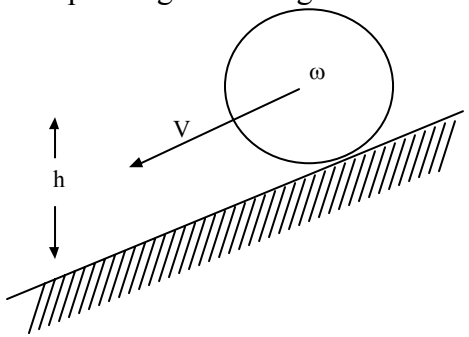
[b] A 30 kg projectile is passing through the origin O with a velocity V_o = 120 **J** m/s. When it explodes into tow fragments A and B of masses 12kg and 18kg respectively. Knowing that 3 seconds later, the position of fragment A is (300, 24, -48)m, determine the velocity of fragment B at the instant of explosion. Assume $a_x = a_z = 0$ and $a_y = -g = -10 m/s^2$. [10]

Q. [5] **[a]** Euler's Theorem states, 'The most general displacement of a rigid body with a fixed point), is equivalent to a rotation of the body about an axis through O;. Prove the statement. [6]

[b] When the power to an electric- motor is turned on, the – motor reaches is rated speed of 33,00 r/min in 6 sec and when the power is turned off, the motor coasts t rest in 80sec. Assuming uniform angular acceleration, determine the number of revolutions that the motor executes. [a] inarching its rated speed, [b] in coasting to rest. [6+4]

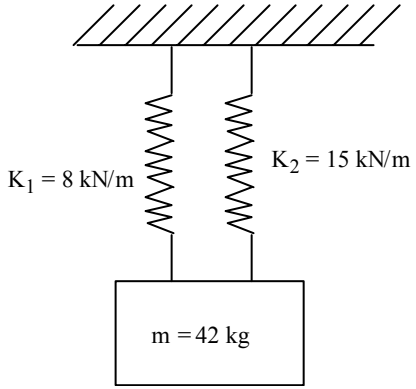
Q. [6] **[a]** What do you mean by linear momentum and angular momentum of a rigid body in plane motion? When are they conserved? In what situation is the angular momentum of a rigid body conserved but not its linear momentum? [2+2+2]

[b] A sphere of mass m and radius r is released form rest on an incline. Determine the velocity after it has rolled a distance corresponding to a change in elevation h. [10]



Q. [7] **[a]** Express the angular momentum of a rigid body, in its most general form (as summation). Form the relation, derive the formula relating it to angular velocity and centroidal momentum of inertia. [2+2+2]

[b] A 42 kg block moves between vertical guides as shown. The block is pulled 50mm down form its equilibrium position and released. Determine the period of the vibration, the maximum velocity, and the maximum acceleration of the block. [5+3+2]



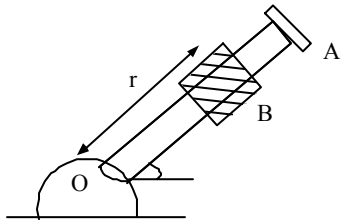
PURWANCHAL UNIVERSITY
II SEMESTER FINAL EXAMINATION-2008

LEVEL : B. E. (Civil.)
SUBJECT: BEG157CI, Applied Mechanics-II (Dynamics)
Full Marks: 80
TIME: 03:00 hrs **Pass marks:** 32

Candidates are required to give their answers in their own words as far as practicable.
All question carry equal marks. The marks allotted for each sub-question is specified along its side.
Answer FIVE questions.

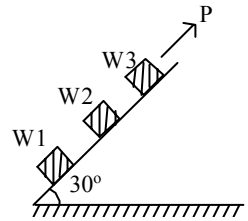
Q. [1] **[a]** Graphical solution are useful to simplify the problems related to dynamics justify this statement. [6]

[b] The rotation of the 0.9m arm OA and O is defined by the relation $\theta = 0.15t^2$, where θ is expressed in radians and t in seconds collar B slides along the arm in such way that its distance form 0 is $r = 0.9 - 0.12t^2$, where r is expressed in meters and t in seconds. After the arm OA has rotated through 30^o, determine (i) the velocity of the collar. (ii) the total acceleration of the collar (iii) the relative acceleration of the collar w.r.t the arm. [10]



Q. [2] **[a]** Kinetic energy of the system is conserved in case of perfectly elastic collision. Do you agree with this statement? If yes, justify it. [6]

[b] A system of three masses is connected by massless rigidrods as shown in fig. If the three masses move 5 ft up the plane under the action of force **P** , find the work done on the and that maximum frictional force is developed between each mass and the surface. [10]

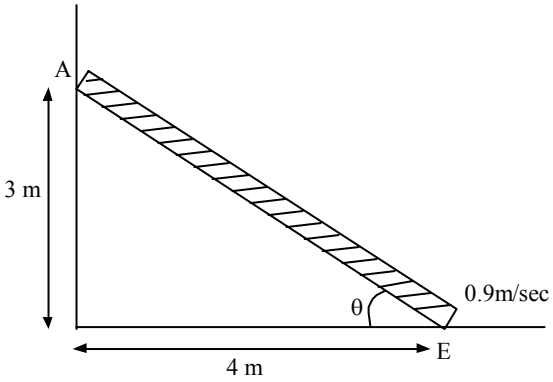


Q. [3] **[a]** Prove that when a particle is moving under central force angular momentum is conserved? [6]

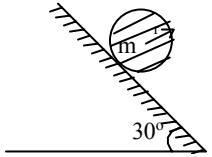
[b] The 4 kg block B stars from rest and slides on the 10kg wedge A, which is supported by a horizontal surface: Neglecting friction , determine (i) the acceleration of the wedge. (ii) the acceleration of the block relative to the wedge. [10]

Q. [4] **[a]** What do you mean by corolis acceleration in plane motion? [6]

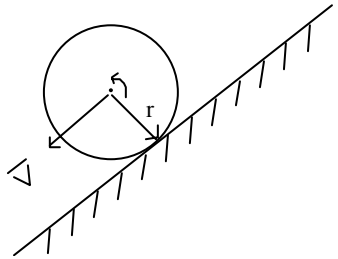
[b] The end B of the rod AB as shown in fig. moves with a constant velocity VB = 0.9m/sec (→). Determine (i) angular velocity and acceleration of the rod (ii) velocity and acceleration of end A. [10]



Q. [5] **[a]** A sphere of radium r and mass m is released without no initial velocity on the incline and rolls without slipping. Determine (i) the minimum value of the coefficient of friction compatible with the rolling motion (ii) The velocity of the centre G of the sphere after the sphere has rolled 4m. (iii) The velocity of G if the sphere were to move 4m down a friction less 30^0 incline. [8]



[b] A sphere, a cylinder and a hoop each having the same mass and the same radius, are released from rest on the incline. Determine the velocity of each body after it has rolled through a distance corresponding to change in elevation h. [8]



Q. [6] What do you mean by free vibrations of rigid body? How can you obtain the effective length of the vibrating plate (i.e rigid body)? [16]

Q. [7] **[a]** Discuss conservative and nonconservative system with examples. [6]

[b] Two spheres 1kg and 2kg are connected by a spring of unstretened length 0.3m with a modulus of 800N/m, move along a smooth plane. At the instant as showing Fig. a force F acts on m_2 . Find the acceleration of each mass and the acceleration of the center mass. [10]