1(a) If \( u = f(x, y) \) is homogeneous function of \( x \) and \( y \) of degree \( n \), show that
\[
x^2 \frac{\partial^2 u}{\partial x^2} + 2xy \frac{\partial^2 u}{\partial x \partial y} + y^2 \frac{\partial^2 u}{\partial y^2} = n(n - 1)u.
\]

OR

(a') If \( z = f(x, y) \), where \( x = e^r \cos \theta \), \( y = e^r \sin \theta \), show that
\[
\left( \frac{\partial z}{\partial r} \right)^2 + \left( \frac{\partial z}{\partial \theta} \right)^2 = e^{2r} \left\{ \left( \frac{\partial z}{\partial x} \right)^2 + \left( \frac{\partial z}{\partial y} \right)^2 \right\}
\]

1(b) If \( u = x + y + z, v = xy + yz + zx, w = x^2 + y^3 + z^3 - 3xyz \), show that \( u, v, w \) are not independent. Also find the relation between them.

2(a) Expand \( f(x, y) = e^x \cos y \) in powers of \( x \) and \( y \) upto the terms of third degree.

2(b) Find the points on the surface \( z^2 = xy + 1 \) nearest to the origin.

OR

(b') Locate the stationary points of \( x^4 + y^4 - 2x^2 + 4xy - 2y^2 \) and determine their nature.

3(a) Find by double integration the area lying inside the cardioid \( r = 1 + \cos \theta \) and outside the paraboloid \( r(1 + \cos \theta) = 1 \).
3(b) Evaluate \( \int_0^a \int_{\sqrt{ax}}^{a} \frac{y^2 \, dy \, dx}{\sqrt{y^4 - a^2 x^2}} \) by changing the order of integration.

OR

(b') Using triple integral find the volume cut from the sphere \( x^2 + y^2 + z^2 = a^2 \) by the cone \( x^2 + y^2 = z^2 \)

4(a) A circle passing through the focus of a conic whose latus rectum is \( 2l \) meets the conic in four points whose distances from the focus are \( r_1, r_2, r_3, r_4 \). Prove that

\[
\frac{1}{r_1} + \frac{1}{r_2} + \frac{1}{r_3} + \frac{1}{r_4} = \frac{2}{l}.
\]

4(b) Trace the conic

\[14x^2 - 4xy + 11y^2 - 44x - 58y + 71 = 0,\]

explaining its main features. Also find its foci and eccentricity.

OR

4(b') Trace the conic

\[x^2 + 2xy + y^2 - 6x + 10y + 25 = 0,\]

explaining its main features. Also find the coordinates of its focus and give the equations of its directrix and latus rectum.
2016-17
B. E. Evening (Winter Semester) EXAMINATION
(Civil/Electrical/Mechanical)
APPLIED PHYSICS
EAP111

Maximum Marks: 60
Credits: 04
Duration: Two Hours

- **Answer ALL the questions. Symbols used have their usual meanings.**
- **Some useful physical constants are given at the end of the questions paper.**

1(a) What is Fermi level? Obtain expressions for electron and hole concentrations in a semiconductor at equilibrium. [6.0]

1(b) With the help of a suitable diagram explain Hall effect and also mention its two applications. [4.0]

1(c) What do you mean by mobility of a charge carrier? For a hypothetical semiconductor, \( \mu_n = \mu_p = 1000 \text{ cm}^2 \text{V}^{-1} \text{s}^{-1} \) and \( N_c = N_v = 10^{19} \text{ cm}^{-3} \). If the conductivity of the intrinsic semiconductor at 300K is \( 4 \times 10^{-6} \text{ } \Omega^{-1} \text{ cm}^{-1} \), what is the conductivity at 600K? [5.0]

2(a) Sketch the path of light inside the core of a reflected and refracted fiber. Obtain an expression for numerical aperture (NA) of an optical fiber. Calculate NA and acceptance angle for an optical fiber whose core and cladding refractive indices are 1.51 and 1.49 respectively. [5.0]

2(b) Write various characteristics of light emitted by a laser and describe some of its important applications. [5.0]

2(c) Why a two level laser is not possible? Explain the construction and working of a semiconductor laser. [5.0]

OR

2(c') Explain the terms: stimulated emission, metastable state, pumping and population inversion. Give an account of He-Ne laser. [5.0]

3(a) What are X-rays? Differentiate between continuous and characteristic X-rays. [4.0]

3(b) What is Compton effect? Obtain an expression for the Compton shift and show that maximum change in wavelength is twice that of Compton wavelength. [7.0]

OR

3(b') Find the energy eigen values and normalized wave functions for a particle in a box of width \( L \). [7.0]

3 (c) Electrons with energies of 1.0 and 2.0 eV are incident on a barrier 10.0 eV high and 0.50 nm wide. (a) Find their respective transmission probabilities. (b) How are these affected if the barrier is doubled in width? [4.0]

Continued......2
4(a) Compare all three kinds of statistical distribution functions. [3.0]

4(b) Deduce the expression for molecular energy distribution and hence show that the average molecular energy is \((3/2) kT\). Calculate the average molecular energy at room temperature (27 °C). [8.0]

OR

4(b') Define electron gas. Obtain an expression for electron energy distribution and hence show that the average electron energy at \(T = 0\) K is \((3/5) \epsilon_F\) [8.0]

4(c) Obtain Einstein’s specific heat formula for solids and show that it reduces to Dulong-Petit’s formula at high temperature. [4.0]

**Some Useful Physical Constants**

- \(h = 6.63 \times 10^{-34}\) J.s,
- \(k = 1.38 \times 10^{-23}\) J/K
- \(m_e = 9.1 \times 10^{-31}\) kg,
- \(m_p = 1.67 \times 10^{-27}\) kg,
- \(c = 3 \times 10^8\) m/s
Q1(a) Discuss the objectives of conducting ecological studies and their benefits. (6)
Q1(b) Enumerate various types of renewable energy sources for the conservation of the environment. (6)

OR

Q1'(a) Explain the various types of environmental pollution caused by mining activity. (6)
Q1'(b) What are natural resources? Discuss about the uses & over-exploitation of forest resources. (6)
Q2(a) Explain the classification of air pollutants on the basis of origin, chemical composition & state of matter? (6)
Q2(b) What are the deleterious effects produced on the human body when exposed to high levels of Air Pollution? (6)

OR

Q2'(a) Differentiate between abiotic and biotic environment with proper classification. (6)
Q2'(b) Explain the causes & effects of a nuclear accident on the earth’s environment. (6)
Q3(a) Explain the various causes of threats to Biodiversity due to Human-wildlife conflict. (6)
Q3(b) Discuss the steps required to be taken to protect the biodiversity for the protection of endangered species. (6)

OR

Q3' Explain the different sources of generation of solid waste and its classification on the basis of origin. Also write the merits & demerits on waste disposal by Incineration technique. (12)

Q4(a) Discuss the importance of sustainable development in modern day world for balanced and environment friendly economy. (6)
Q4(b) Discuss in brief about the importance & objectives of “Water (Prevention and control of pollution) act, 1974”. (6)
Q5 Write short notes on the following: (4x3=12)
(a) Mortality (b)Natality (c)Population Density (d)Population Explosion.
2016-2017

B.E.WINTER (II SEMESTER) EXAMINATION
(CIVIL/ELECTRICAL/Mechanical)
ENGLISH
(FEN-101)

Max Marks: 60

UNIT I

Duration: Two Hours
(2x6=12)

1. (a) Read the passage and answer the questions that follow:

Teaching is the noblest of professions. A teacher has a sacred duty to perform. It is he on whom rests the responsibility of moulding the character of young children. Apart from developing their intellect, he can inculcate in them qualities of good citizenship, remaining neat and clean, talking decently and sitting properly. These virtues are not easy to be imbibed. Only he who himself leads a life of simplicity, purity and rigid discipline can successfully cultivate these habits in his pupils.

Besides a teacher always remain young. He may grow old in age, but not in spirit. Perpetual contact with budding youths keeps him happy and cheerful. There are moments when domestic worries weigh heavily on his mind, but the delightful company of innocent children makes him overcome his transient moods of despair.

1. The author’s tone in the given passage is:
   a. critical  b. apprehensive  c. complimenting  d. sarcastic

2. Apart from developing a child’s intellect, teachers make them a good ________
   a. scholar  b. citizen  c. student  d. friend

3. An ideal teacher leads a life of ________
   a. luxury  b. comfort  c. simplicity  d. none of these

4. According to the passage, how can a teacher overcome his/her transient mood when at times domestic worries overburden him/her?
   a. by sharing with a colleague
   b. by avoiding his/her students
   c. by the delightful company of innocent children
   d. by the delightful company of family members

5. Change the following into its adjective form:
   a. Simplicity
   b. Purity

6. Make sentences from the following words:
   a. Citizen
   b. Discipline

UNIT II

2. A. Discuss the process through which Napoleon established absolute dictatorship.
   OR,
   Discuss the significance of the dream of Old Major.  (6+6=12)

B. Critically examine the perception of the time traveller of the human civilization in 802701 AD
   OR,
   Comment on the life pattern of Eloi and Morlocks

3. Write the process of generating either solar energy or opening a new saving bank account
   OR,
Write a report in detail on the ZERF-2017 recently held at ZHECT, AMU, Aligarh

UNIT IV:

4. Read the passage given below and write a précis of the passage.
   Also give a suitable title.
   (12)

The Earth’s crust moves when blocks of the earth abruptly slip past one another. This results in an Earthquake. Earthquakes are related to cracks in the crust called faults. Faults may have formed from an earlier earthquake or while an earthquake is occurring. During an earthquake the crust is in motion. The earthquake vibrations travel through the crust and people feel the intensity depending on the distance from the source. The location below where the earthquake starts is called the hypocentre, and the area directly above it on the surface of the earth it is called the epicentre.

A seismograph is a device that records the motion at locations all around the crust. The size of an earthquake is called its magnitude. There is one magnitude for each earthquake that takes place. The lower the magnitude of an earthquake the less damage is done to a town or city. Large earthquakes can destroy entire towns and cities. Earthquakes in the United States are more likely to occur along the West Coast, but they can also occur in the Midwest and along the East Coast.

An underwater earthquake can cause a tsunami. A tsunami is a large ocean wave which can reach the coastlines and cause major damage and flooding. Earthquakes may also be the cause of some volcanoes to become active and erupt.

A volcano is a rupture on the crust of the Earth that allows hot lava, volcanic ash, and gases to escape from a magma chamber below the surface. The hot molten rock deep below Earth’s surface is called magma and it rises upward. If the magma reaches the surface of the Earth it may flow out as lava, or it is hurled out when the volcano erupts. Magma is liquid rock inside the volcano; lava is liquid rock on the outside of the volcano.

UNIT V:

5. Write an essay in about 200 words on any one of the following: (12)

a. Education and promotion of scientific temperament

b. Technology and unemployment

c. English as a global language
2016-17
B.E. (WINTER SEMESTER) EXAMINATION
CIVIL/ ELECTRICAL/ MECHANICAL ENGINEERING
APPLIED MECHANICS
EME 111

Maximum Marks: 60
Credits: 04
Duration: Two Hours

Use separate answer sheets for Part A and Part B
Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question

PART - A

1(a) A 110 N force acting in a vertical plane parallel to the \(yz\)-plane is applied to the 200 mm long horizontal handle AB of a socket wrench shown in Fig. 1. Replace the force with an equivalent force-couple system at the origin O of the coordinate system.

1(b) A uniform pipe cover of radius \(r = 240 \text{ mm}\) and mass 35 kg is held in a horizontal position by the cable CD as shown Fig. 2. Assuming that the bearing at A does not exert axial thrust determine the tension in the cable and the reactions at A and B.

Fig. 1

Fig. 2

contd... 2
1'(a) Using the method of virtual work, determine the magnitude of the couple $M$ required to maintain the equilibrium of the mechanism shown Fig. 3.

1'(b) A 100-kg uniform rectangular plate as shown in Fig. 4, is supported in the position shown by hinges A and B and by cable DCE that passes over a frictionless hook at C. Assuming that the tension is the same in both parts of the cable, determine (a) The tension in the cable and (b) The reactions at A and B. Assume that the hinge at B does not exert any axial thrust.

![Fig. 3]

![Fig. 4]

2(a) A 20 kg package shown in Fig. 5, is at rest on an incline when a force $P$ is applied to it. Determine the magnitude of $P$ if 10 s is required for the package to travel 5 m up the incline. The static and kinetic coefficients of friction between the package and the incline are both equal to 0.3.

2(b) Block B moves downward with a constant velocity of 20 mm/s as shown in Fig. 6. At $t = 0$, block A is moving upward with a constant acceleration, and its velocity is 30 mm/s. Knowing that at $t = 3$ s slider block C has moved 57 mm to the right, determine the velocity of slider block C at $t = 0$ and the accelerations of A and C. What will be the change in position of block A after 5 s.
2(b) The system shown in Fig. 7, is at rest when a constant 150-N force is applied to collar B. (a) If the force acts through the entire motion, determine the speed of collar B as it strikes the support at C. (b) After what distance $d$ should the 150-N force be removed if the collar is to reach support C with zero velocity?

3(a) At the instant considered the radar antenna shown in Fig. 8, rotates about the origin of coordinates with an angular velocity $\omega = \omega_x \, \mathbf{i} + \omega_y \, \mathbf{j} + \omega_z \, \mathbf{k}$. Knowing that $(v_A)_x = 100 \, \text{mm/s}$, $(v_A)_y = 290 \, \text{mm/s}$, and $(v_B)_z = 120 \, \text{mm/s}$, determine the angular velocity of the antenna and the velocity of point A.

3(b) A circular plate of 120 mm radius is supported by two bearings A and B as shown in Fig. 9. The plate rotates about the rod joining A and B with a constant angular velocity of 26 rad/s. Knowing that, at the instant considered, the velocity of Point C
is directed to the right, determine the velocity and acceleration of point E.

PART – B

4(a) A steel rod 20mm in diameter passes centrally through a steel tube of 25mm internal diameter and 30 mm external diameter. The tube is 800mm long and is closed by rigid washers of negligible thickness which are fastened by nuts threaded on the rod. The nuts are tightened until the compressive load on the tube is 20 kN. Calculate the stresses in the tube and the rod.

4(b) At a point in a material, there are two normal tensile stresses of magnitude 20MPa and 10MPa acting mutually perpendicular to each other. There is also a positive shear stress of 5MPa acting at that point. Determine the normal and shear stresses on a plane whose normal is inclined at 60° to 20MPa stress.

OR

4′(a) A 4.0 m long beam with rectangular section 10 cm wide and 20cm deep is simply supported at the ends. Find the same uniformly distributed load that it can carry if the permissible bending stress is 70 N/mm².

4′(b) A solid steel shaft is to transmit 75 KW at 200 rpm. Taking allowable shear stress as 70MPa, find suitable diameter of the shaft, if the maximum torque transmitted in each revolution exceeds the mean by 30%. Also find the outer diameter of the shaft if inside diameter is 0.7 of the outside diameter, which can replace the solid shaft.

5 Draw SFD and BMD for the beam shown in Fig. 10.