1. Answer the following:
   (i) Principle of gravimetric analysis
   (ii) Colorimetric titrations
   (iii) Primary and secondary standards
   (iv) Analyte and titrant
   (v) Requirements of a titrimetric method

OR

1'(a) Write Beer-Lambert’s law and describe various terms involved.

A sample of iron in 1.0 cm cell showed an absorbance of 0.46 at 540 nm wavelength.
Find out the concentration of iron if absorptivity of the sample is 1.54 l. g⁻¹ cm⁻¹.

1'(b) Explain the followings:
   (i) Mechanism of ion-exchange chromatography
   (ii) Stationary and mobile phases

2(a) Giving chemical equations, explain the water softening by zeolite process and list its limitations.

2(b) A sample of water on analysis gave the following results:

\[ \text{Ca(HCO}_3\text{)}_2 = 21.8 \text{ mg/L}; \text{Mg(HCO}_3\text{)}_2 = 18.6 \text{ mg/L}; \text{CaSO}_4 = 16.4 \text{ mg/L}; \text{MgCl}_2 = 10.6 \text{ mg/L}; \text{Fe}_2\text{O}_3 = 1.8 \text{ mg/L}; \text{Na}_2\text{SO}_4 = 5.6 \text{ mg/L}. \]

(a) Calculate temporary and permanent hardness of the water sample in mg/L.
(b) Calculate the amount of lime and soda required to soften 10⁵ litres of this water.

Contd...
OR

2. Write brief notes on the followings:
   (i) Sedimentation with coagulation
   (ii) Break point chlorination
   (iii) Boiler corrosion
   (iv) Reaction of lime with impurities causing temporary hardness

3(a) Define gross and net calorific values. Describe the determination of calorific value of a solid fuel by bomb calorimeter.

3(b) Describe Bergius process for the preparation of synthetic petrol.

4. Explain the followings:
   (i) Mechanism of boundary lubrication
   (ii) Silicon fluids
   (iii) Viscosity and viscosity index
   (iv) Conditions where grease is used as lubricant

5. Write notes on the followings:
   (a) Mechanism of electrochemical corrosion by absorption of oxygen
   (b) Electrochemical series and its importance
   (c) Corrosion control by proper designing

6(a) Give the preparation, properties and uses of any two of the following polymers:
   (i) Polyesters
   (ii) Buna N
   (iii) PTFE

6(b) What is natural rubber? Give its limitations.

6(c) Distinguish between thermoplastics and thermosetting plastics.
B.Tech All Branches (I SEMESTER) EXAMINATION
Atmospheric Chemistry
AC-308

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No. Question M.M.

1(a) Enlist the various zones of the atmosphere and discuss the significance of stratosphere. [5]

1(b) What is photochemical smog? Write the photochemical reactions involved in the formation of photochemical smog. [5]

OR

1'(a) Write short notes on any two of the following alternative fuels: [5]

(i) P-Series
(ii) Biodiesel
(iii) CNG

1'(b) What is the importance of indoor air quality? Describe the factors affecting the indoor air quality. [5]

2(a) What is clean air act? Define criteria pollutants and discuss the sources and significance of carbon monoxide/sulphur dioxide. [5]

2(b) Define particulate matter and give its classification. Describe the effects of particulate matter on human health. [5]

3(a) Why the gaseous pollutants are monitored? How CO or NH₃ are quantitatively estimated? [5]

3'(b) Write a brief notes on any two of the following: [2.5x2]

(i) Grab sampling and condensation
(ii) Fourier Transform Infrared spectrometry

Contd....2.
(iii) Atomic Absorption Spectrometry

4 (a) What is the principle of wet collectors? Explain cyclone scrubber method in air pollution control. [6]

4 (b) Discuss any two of the followings in brief: [4]
   (i) Fabric filters
   (ii) Venture scrubber
   (iii) Electrostatic precipitator

5 What are natural cycles? Explain the carbon and nitrogen cycles in detail. [10]

6 (a) What is the significance of Green House effect? Describe the various regional impacts of global warming. [6]

6 (b) Discuss the formation and depletion of ozone. [4]
Max Marks: 60

Duration: Three Hours

Note: Solve all questions.

1. (a) Determine the values of \( a, b \) for which the system of equations
\[ \begin{align*}
3x - 2y + z = b, \\
5x - 8y + 9z = 3, \\
2x + y + ax = -1
\end{align*} \]
has (i) a unique solution (ii) infinitely many solutions (iii) no solution.

(b) Find the eigenvalues and eigenvectors of the matrix
\[ A = \begin{bmatrix}
0 & -2 & 2 \\
-2 & 3 & -1 \\
2 & -1 & 3
\end{bmatrix} \]
also find the eigenvalues of \( 3A + 4A - 6A + 2I \).

OR

(b') Find the characteristic equation of matrix \( A = \begin{bmatrix} 4 & 2 & 1 \\
2 & 1 & -2 \\
1 & 2 & 1 \end{bmatrix} \) Hence find \( A^4 \).

2. (a) Find the pedal equation of the curve \( r^n = a^n \cos n\theta \).

(b) Trace the curve \( y = \frac{x^2}{(1-x^2)^n} \) by discussing its salient features.

OR

(b') Show that the asymptotes of the curve \( x^3 - 2y^2 + xy(2x-y) + y(x-y) + 1 = 0 \) cut the curve again in three points which lie on the line \( x - y + 1 = 0 \).

3. (a) If \( y = \frac{\sin^{-1} x}{\sqrt{1-x^2}} \), prove that \( \left( 1-x^2 \right) \frac{dy}{dx} = xy + 1 \). By applying Leibnitz theorem show that
\[ \left( 1-x^2 \right) y_{n+1} - (2x + 1)xy_n - x^2y_{n-1} = 0 \]
OR

(a') Prove by Maclaurin’s expansion that
\[ \log \cos x = \frac{1}{2} x^2 - \frac{1}{12} x^4 + \frac{1}{45} x^6 \ldots \]

(b) (i) Test convergence of the series whose general term is
\[ \frac{1}{\sqrt{n} + \sqrt{m} + 1} \]

\[ \text{Contd...2} \]
(ii) Test the convergence of the series
\[ 1 + \frac{2}{5} x + \frac{6}{9} x^2 + \frac{14}{17} x^3 + \frac{2^n - 2}{2^n + 1} x^{n-1} + \ldots \]

4. (a) Find the intrinsic equation of the parabola \( y^2 = 4ax \).
(b) Show that the volume of the solid generated by the revolution of the curve
\[ y = \frac{a^3}{a^2 + x} \]
about its asymptote is \( \frac{1}{2} \pi^2 a^3 \).

OR

(b') Find the area of the surface formed by the revolution about the \( x \)-axis of an arch of
cycloid \( x = a(t - \sin t) \), \( y = a(1 + \cos t) \).

5. (a) Solve any two of the following differential equations

(i) \( (x^2 e^x - 2y^2) dx - 2xy \, dy = 0 \)

(ii) \( \frac{d^3 y}{dx^3} - 2 \frac{dy}{dx} + 4y = x^2 + 4 \sin x \)

(iii) \( x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} + y = x + \log x \)

(b) Solve the following system of equations:
\[
\begin{align*}
\frac{dx}{dt} + 2x + 3y &= 0 \\
\frac{dy}{dt} + 3x + 2y &= 2e^{2t}
\end{align*}
\]

OR

(b') A liquid in a test tube cools from 70°C to 60°C in 4 minutes, the room temperature being 30°C. Determine the temperature of the liquid as a function of time, and time taken in cooling down to 40°C.
B.TECH/B.ARCH. ACTUM (I SEMESTER) EXAMINATION
(ELECTRICAL/MECHANICAL/CIVIL/ELECTRONICS/COMPUTER/CHEMICAL/
PETRO-CHEMICAL ENGINEERING
MATHEMATICS-I
(A.M-111)
Credits: 04

MAXIMUM MARKS : 60
DURATION : THREE HOURS

Note : Answer all questions.

Q.1  (a) Test the consistency and hence solve \( x_1 + 2x_2 - x_3 = 2, \ 3x_1 + x_2 - 2x_3 = 1, \)
\( 4x_1 - 3x_2 - x_3 = 3, \ 2x_1 + 4x_2 + 2x_3 = 4. \)

(b) Find the eigenvalues and eigen vectors of the matrix \( \Lambda = \begin{bmatrix} 3 & 1 & 4 \\ 0 & 2 & 6 \\ 0 & 0 & 5 \end{bmatrix} \)

OR

(b') State Cayley-Hamilton theorem. Verify the theorem for the matrix
\( \Lambda = \begin{bmatrix} 1 & 2 \\ 1 & 3 \end{bmatrix} \)
and express \( \Lambda^5 - 4\Lambda^3 + 8\Lambda + 12\Lambda^3 + 14\Lambda^2 \) as a linear polynomial
in \( \Lambda. \)

Q.2  (a) Find the asymptotes of the curve \( 4(x^2+y^2) = 17x^2y^2 - 4(x^2-y^2)^2 \)
and show that they pass through the points of intersection of the curve with the
equation \( x^2 + 4y^2 = 4. \)

(a') Trace the curve \( y = \frac{x^2+1}{x^2-1} \) mentioning its salient features.

(b) (i) If \( \cos^{-1} \left( \frac{y}{b} \right) = \log \left( \frac{x}{a} \right) \), show that \( x^2 y_{xxx} + (n+1) xy_{xxx} + 2n^2 y_x = 0 \)

(ii) Express \( \log(\sin x) \) in powers of \( (x-3) \) by Taylor's theorem. Write at least
three non-zero terms.

Q.3  (a) Find the intrinsic equation of the curve \( \tau = a (1 - \cos \theta) \)

(b) The hyperbola \( \frac{x^2}{a^2} - \frac{y^2}{b^2} = 1 \) is revolved about x-axis. Find the volume cut off
from one of two solids thus obtained by a plane perpendicular to x-axis and
distance h from the vertex.

(b') Find the area of the surface formed by revolutions about x-axis of an arc of
cyloid \( x = a (t + \sin t), \ y = a (1 + \cos t), \)

OR

Q.4  (a) Solve any three of the following

(i) \( \frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + 2y = x \)

(ii) \( \frac{d^2 y}{dx^2} + 4y = \sin^2 x + x^3 e^x \)

Contd....2
(iii) \( x^2 \frac{d^2 y}{dx^2} - x \frac{dy}{dx} - 3y = x^2 \log x \)

(iv) \( 2x^2 \frac{d^2 y}{dx^2} + 7x \frac{dy}{dx} - 3y = x^2 \frac{1}{x^2} \)

(b) Solve the simultaneous differential equation

\[
\begin{align*}
\frac{dx}{dt} + 4x + 3y &= t \\
\frac{dy}{dt} + 2x + 5y - e^t
\end{align*}
\]

OR

(b') A body falling from rest is subjected to the force of gravity and air resistance proportional to the square of the velocity. If the resistance is equal to the weight of the body when speed is \( b \), show that the distance traveled by the body in \( t \) seconds is given by

\[
\frac{b^2}{g} \log \left( \frac{\cosh \left( \frac{gt}{b} \right)}{\cosh \left( \frac{b}{b} \right)} \right)
\]
Maximum Marks: 60  
Credits: 03  
Duration: Three Hours

Note: Answer all the questions. Symbols used have their usual meanings.

1(a) What are direct and indirect band gap semiconductors? Draw E vs. k diagrams and give four examples in each case. [5.0]

1(b) Define mobility of a charge carrier. Taking contribution of electrons and holes, obtain an expression for current density hence write electrical conductivity. [6.5]

1(c) A Si sample is doped with $10^{17}$ As atoms/cm$^3$. Where is $E_F$ relative to $E_i$ at 300 K? (Given: $n_i=1.5\times10^{10}$ cm$^{-3}$ and $k_B=1.38\times10^{-23}$ J/K) [3.5]

2(a) What are the postulates of special relativity? Write down Lorentz transformation. Derive an expression for relativistic length contraction using Lorentz transformation. [6.0]

2(b) Write down Maxwell’s equations. Considering travelling electromagnetic waves and using concept induced electric and magnetic field establish the relation. $c=1/(\mu_0\varepsilon_0)^{1/2}$ [6.0]

2(c) An electron ($m_0=0.511$ MeV/c$^2$) and a photon ($m_0=0$) both have momenta 2.00 MeV/c. Find total energy of each. [3.0]

3(a) Explain Compton effect? Obtain an expression for the wavelength shift, $(\lambda'-\lambda)$ when a photon is scattered by an electron at rest, i.e., $(\lambda'-\lambda)=(h/m_0c)(1-\cos \theta)$ [8.0]

3(b) A 2 nm photon is scattered through an angle 60° by an electron at rest. Estimate the wavelength of the scattered photon. [3.0]

3(c) What do you mean by pair production? Show that pair production cannot occur in free (empty) space. [4.0]

OR

3'(a) What are continuous and characteristic X-rays? Briefly discuss the production mechanisms of these rays. Mention the approximate wavelength range of X-rays. [5.0]

3'(b) What are phase and group velocities? Show that the velocity of the wave group associated with a moving particle is always equal to the velocity of the particle. [5.0]

3'(c) Discuss Heisenberg uncertainty principle. Mention various uncertainty relations you know and obtain qualitatively the uncertainty relation; $\Delta x \cdot \Delta p \geq \frac{\hbar}{2}$ [5.0]

Contd..... 2.
4(a) Define expectation value of a physical quantity. Set up the time dependent form of
Schrödinger equation and hence deduce its time independent (steady state) form. [9.0]

4(b) Write the normalized wave function of a particle trapped in a box L wide and
hence find the probability of finding the particle in the box between x=0 and x=L/n
when it is in the n\textsuperscript{th} state. [6.0]

OR

4'(b) Electrons with energies of 0.5 eV are incident on a barrier 3.0 eV high and
0.10 nm wide. Find the approximate probability for these electrons to penetrate
through the barrier. [6.0]

\textbf{Some useful physical constants}

\begin{align*}
h &= 6.63 \times 10^{-34} \text{ J.s} \\
m_e &= 1.67 \times 10^{-27} \text{ kg} \\
\rho_{\text{Si}} &= 1.5 \times 10^{18} \text{ m}^{-3} \\
k_B &= 1.38 \times 10^{-23} \text{ J/K} \\
m_\text{O}_2 &= 32 \text{ amu} \\
e^- &= 1.6 \times 10^{-19} \text{ C} \\
c &= 3 \times 10^8 \text{ m/s} \\
m_e &= 9.1 \times 10^{-31} \text{ kg} \\
1 \text{ amu} &= 1.66 \times 10^{-27} \text{ Kg}
\end{align*}
2015-16
B.TECH. (AUTUMN SEMESTER) EXAMINATION
(Civil/Chemical/ Computer/ Electrical/ Electronics/ Mechanical/ Petro-Chemical/ Arch. Engg.)
APPLIED PHYSICS
AP-111

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

1(a) Discuss Hall effect in the case of a p-type semiconducting sample. Obtain an expression for majority carrier concentration in terms of measurable parameters in the given sample. What are the important applications of Hall probe?

OR

1(a') Define Fermi level $E_F$. Derive an expression for carrier concentration in conduction band at equilibrium for a semiconductor and explain shifting of Fermi level with the doping concentration.

1(b) Find the resistivity of intrinsic Ge at 300 K. (Given: $m_e^* = 0.56 m_0$, $m_p^* = 0.37 m_0$, $E_g = 0.67$ eV, $n_e = 3900$ cm$^{-3}$/V.s and $\mu_p = 1900$ cm$^2$/V.s)

2(a) Define numerical aperture and obtain an expression for numerical aperture in the case of a step index fiber in terms of refractive indices of core and cladding.

2(b) What are the advantages of optical fiber communication system over conventional communication system?

2(c) Calculate angle of acceptance for step index silica fiber having refractive indices 1.48 and 1.42 for core and cladding respectively.

3(a) Define the terms: induced absorption, spontaneous emission and stimulated emission. Discuss construction and working of He-Ne laser with the help of suitable diagrams. Compare this laser with the ruby laser.

3(b) If the angular spread of a laser beam is ideally diffraction limited and is given by $\theta_0 = 1.22\lambda/D$, where $\theta_0$ can be considered the angle between a line parallel to the center of the beam and a line parallel to the "edge" of the beam, $\lambda$ is the wavelength of laser and $D$ is the diameter of the rod. For a ruby laser of diameter 1 cm and wavelength 6943 Å, what would be the radius of a spot projected on a screen placed at a distance of 1 km?

4(a) With the help of suitable diagram discuss the production mechanism of X-rays and explain the term: Duane-Hunt limit, continuations and characteristic X-rays.

4(b) An X-ray photon having frequency $1.5 \times 10^{16}$ Hz undergoes Compton scattering.
with an electron and emerges with a frequency of $1.2 \times 10^{12}$ Hz. Find the kinetic energy (in joules) imparted to the electron.

OR

4' (a) Explain the terms-phase velocity and group velocity. Obtain the expression for group velocity, $v_g = (d\omega / dk)$ and show that the group velocity, $v_g$ associated with a moving particle is always equal to the velocity of the particle, $v$.

4' (b) Find the shortest wavelength present in the radiation from an x-ray machine whose accelerating potential is 50,000 V.

5 (a) Explain the physical significance of the wave function, $\psi$ and discuss the necessary conditions for it to be physically acceptable.

5 (b) Write the steady state form of Schrödinger equation and solve it for the energy and the normalized wave function of a particle trapped in a box (infinite square potential well) L wide. Plot the wave function and the corresponding probability densities for the three lowest quantum states.

6 (a) Discuss the physical significance of Fermi energy. Use the expression for number of quantum states, $g(\epsilon)\delta\epsilon$ of free electrons in metals to obtain an expression for Fermi energy. Show that average electron energy at 0 K is $3/5 \epsilon_F$.

6 (b) Draw a curve showing the distribution of electron energies in a metal at various temperatures. Explain why the electrons in a metal do not contribute to its specific heat?

OR

6' (a) Obtain classical result on specific heats of solids at constant volume and give its limitations. Discuss Einstein's explanation of specific heats of solids and show that this result reduces to classical result at higher temperatures.

6' (b) Find the Fermi energy of tungsten on the assumption that each tungsten atom contributes two free electrons to the electron gas. The density of tungsten is 19.3 g cm$^{-3}$ and its atomic mass is 183.8 amu.

---

**Some Useful Physical Constants**

- $h = 6.63 \times 10^{-34}$ J.s
- $k_B = 1.38 \times 10^{-23}$ J/K
- $m_e = 9.1 \times 10^{-31}$ kg
- $m_p = 1.67 \times 10^{-27}$ kg
- $m(O_2) = 32$ amu
- $c = 3 \times 10^8$ m/s
- $n(Si) = 1.5 \times 10^{16}$ m$^{-3}$
- $q_e = 4.8 \times 10^{-19}$ C
- 1 amu = $1.66 \times 10^{-27}$ kg
# 2015-16
## B.Arch. First Semester Examination
### Architectural Drawing - I
#### AR-103

**Maximum Marks:** 40  
**Credits:** 0.6  
**Duration:** Three Hours

**Answer all the questions.**  
**Assume suitable data if missing.**  
**Neat and good drafted drawings will be credited more.**

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
</table>
| 1     | Represent the followings:-  
  a) An aircraft in side elevation.  
  b) Plants in elevation.  
  c) Wooden Texture (in box size 80 mm X 60 mm)  
  d) Brick work in elevation (in box size 80 mm X 60 mm) | 3  
  3  
  2  
  2 |
| 2     | A square prism of base 30 mm side and height 65 mm has its axis inclined at 45° to H.P. It has an edge of its base on H.P. which is inclined at 30° to V.P. Draw its orthographic projections. | 10 |
| **OR** | **A regular pentagonal pyramid with the sides of its base 30 mm and height 80 mm rests on an edge of the base. The base is tilted until its apex is 50 mm above the level of the edge of the base on which it rests. Draw orthographic projection of the pyramid when the edge on which it rests, is parallel to the V.P. and the apex of the pyramid is towards V.P.** | 10 |
| 3     | A cylinder of base diameter 50 mm and height 60 mm is resting on ground on its base. A circular hole of diameter 40 mm is cut through the cylinder. The axis of the hole is horizontal and intersect the axis of the cylinder at 25 mm above base of cylinder. Draw the development of surface of truncated cylinder. | 10 |
| 4     | Draw isometric view of the object shown in figure - 1. | 10 |

**Contd. .... 2.**
FIGURE - 1

(Figures showing Front Elevation, Side Elevation, and Plan with dimensions in mm.)
<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>M.M.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Explain the need of architecture in the present scenario and what is the role of an architect in shaping a society?</td>
<td>[10]</td>
</tr>
<tr>
<td>2</td>
<td>What are the principles of architectural design, explain with figure the different types of hierarchy?</td>
<td>[10]</td>
</tr>
<tr>
<td>3</td>
<td>What are the indispensable elements of architectural design, explain with sketches how lines are employed in any architectural symphony?</td>
<td>[10]</td>
</tr>
<tr>
<td>3'</td>
<td>Explain the City of Chandigarh as a remarkable work of Le Corbusier?</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>Explain with neat sketches, how mathematics as a subject plays an important in architecture from ancient time?</td>
<td>[15]</td>
</tr>
<tr>
<td>4'</td>
<td>How do physics be germane in architecture, explain with figure, what are the various important applications of physics in building industry?</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>Explain the basic philosophy of Zaha Hadid and how does she incorporates her philosophy in designing the buildings?</td>
<td>[15]</td>
</tr>
</tbody>
</table>
Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions. 
Assume suitable data if missing. 
Notations used have their usual meaning.

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Question</th>
<th>Marks</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>What is biodiversity? Explain any two levels at which biodiversity can be determined.</td>
<td>[05]</td>
</tr>
</tbody>
</table>
| 1(b)  | Write short notes on any two of the following  
   i. Values of biodiversity  
   ii. Role of economy, environment and society in sustainable developments  
   iii. Rain Water Harvesting | [05] |
| 2(a)  | Differentiate between the exponential and the logistical population growth rate and explain the importance of carrying capacity. | [05] |
| 2(b)  | What is the role of Information Technology on environment and human health  
   OR  
   Briefly discuss the disaster mitigation plan for any natural disaster. | [05] |
| 3(a)  | Discuss the energy flow concept in ecological pyramid. What is ecological succession in ecosystem? | [05] |
| 3(b)  | What are different water quality parameter? What are persistent organic pollutants and their health effects on humans? | [05] |
| 4(a)  | Suggest a water treatment scheme for ground water having hardness. Briefly discuss its each unit.  
   OR | [05] |

Contd.....2.
4'(a) Draw typical wastewater treatment scheme for domestic sewage. [05]

4'(b) What are different functional elements of solid waste management? Explain any disposal technique for municipal solid waste. [05]

5(a) Explain the aims and Objectives of Air (Prevention and Control of Pollution) Act, 1981? Also briefly describe its important features. [05]

OR

5'(a) What is Global Warming? How it is responsible for Climate Change? [05]

5'(b) What is ozone and where is it in the atmosphere and how it is formed in the atmosphere? [05]

6(a) Discuss renewable and nonrenewable sources of energy? And write a short note on alternate energy sources of energy? [195]

6(b) Explain the aims and Objectives of Forest Conservation Act, 1980? Also briefly describe its important features. [05]

OR

6'(b) What is Acid rain? Also mention its causes and effects on environment. [05]
Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q. No. Question M.M. (06)
1(a) Find the Average value and RMS value of the following waveform.

![Waveform Diagram]

1(b) Using phasor diagram, obtain the relationship between line voltage and phase voltage for a star connected system.

OR

1' Determine the current I_1 in the circuit given below using superposition theorem.

![Circuit Diagram]

2(a) What are different types of magnetic losses? How can they be minimized?

2(b) The no-load current of a transformer is 4 A at 0.25 p.f. when supplied at 250 V, 50 Hz. The number of turns on the primary winding is 200. Calculate:

(i) Flux in the core
(ii) The core loss
(iii) Magnetizing current

OR

2' A magnetic circuit shown in figure below is constructed of wrought iron. The cross section of central limb is 6 cm² and each outer limb is 4 cm². If the coil is wound with

Contd... 2.
300 turns, calculate the exciting current required to setup a flux of 0.9 mWb in the central limb. BH curve of wrought iron are:
H (AT/m) : 500 2000
B (Wb/m$^2$) : 1.125 1.5

3(a) Why is single phase induction motor not self-starting? Discuss any one method of starting a single phase induction motor.

3(b) A three phase 50 Hz, 4 pole induction motor has an induced emf in the rotor with a frequency of 2 Hz, calculate:
(i) Synchronous speed
(ii) Slip
(iii) Speed of the motor

OR

3' (a) Explain principle of operation of 3 phase induction motor.
3' (b) A three phase 16 pole alternator has a star connected winding with 144 slots and 10 conductors per slot. The flux per pole is 0.03 Wb sinusoidally distributed and the speed is 375 RPM. Calculate:
(i) The frequency
(ii) The line induced emf

4(a) Explain the principle of operation and application of moving coil instruments

4(b) With the help of neat diagram explain the working of induction type energy meter.

5(a) Draw and explain the single line diagram of power system

5(b) Classify hydroelectric power plant according to:
(i) Head
(ii) Load
(iii) Plant capacity
(iv) Water-flow regulation
Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning. Part A (Q1 & 2) and Part B (Q3 & 4) are to be answered in separate copies.

Q.No.       Question            M.M.
           PART A
1(a)       Sketch the following theorems for AC network:
           (a) Thevenin's theorem.
           (b) Norton's theorem.

1(a')      Determine the current 'I' in the circuit shown using the superposition theorem:

![Circuit Diagram]

1(b)       In star connection by using Phasor diagram show that:

\[ |V_{ab}| = |V_{bc}| = |V_{ca}| = V_L = \sqrt{3} V_f \]

1(c)       What are hysteresis and eddy current losses? How they can be minimized?

1(c')      Draw exact equivalent circuit of the transformer referred to the primary. Also, draw the approximate equivalent circuit of the transformer referred to the primary as well as secondary.

Contd....2.
2(a) Explain the principle of operation of a three-phase induction motor.

2(b) With the help of diagram, explain the construction and principle of operation of repulsion type MI instrument.

2(b') With the help of diagram, explain the driving system and moving system of the induction type single-phase energy meter.

2(c) How the hydroelectric power plant generates electricity? Write the factors that should be considered for selecting the site of hydroelectric power plant. Also, write its advantages.

**PART B (to be answered in a separate copy)**

3(a) Explain the current equation of PN junction diode.

3(b) a) For the Zener diode network of Fig. 3(b), determine $V_Z$, $V_R$, $I_Z$, and $P_Z$.

b) Repeat part (a) with $R_L = 3 \, k\Omega$.

![Zener diode network diagram]

Fig. 3(b)

3(b') Determine $V_C$ and $P_S$ for the network of Fig. 3(b').
Fig. 3(b)'

3(c) Draw the circuit diagram of a center-tapped full-wave rectifier circuit, indicating the direction of current paths during positive and negative half cycles of input. Explain its operation and determine its peak inverse voltage.

4(a) Explain the construction, working and characteristics of an n-channel enhancement-type MOSFET.

4(b) What are the different characteristics of an ideal operational amplifier? Also, explain the significance of virtual ground in an operational amplifier.

4(c) Describe the integrator and differentiator circuit using op-amp.

OR

4(c)' Design an operational amplifier circuit that will produce output voltage:

\[ V_o = 0.5V_1 - 2V_2 \]
UNIT - I

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

Our need for water is constantly increasing. There is an automatic increase due to population growth, while the overall improvement of living standards, the fight against hunger through the irrigation of more land for food growing, and the creation and expansion of new industries, all fuel the need for even greater water supplies throughout the world. Though it is difficult to calculate the exact amount, it's safe to say that in 20 years time the demand for water will be roughly double. Faced with such a situation it is obvious that we should search as widely as possible and with every available means for sources of fresh water that seem to be the least costly. But where do these sources exist? Only a sustained and coordinated programme of scientific observation and research in hydrology will tell us the answer.

Underground water reserves are much larger than those on the surface, but as they are unseen we tend to underestimate them. It is virtually important that we make use of these underground reserves, but never haphazardly. For example, where does the water come from which we find in one or another of the underground water-bearing layers? How does it move? How is it renewed? What are the laws of hydrogeology? Despite the immense progress of recent years, all these questions have still not been fully answered.

(i) Hydrology is the study of:
   (a) Electricity  (b) Water resources  (c) Gases  (d) None of the above

(ii) Give two reasons for increasing water consumptions?

(iii) In order to find fresh water the farmer recommends the study of ........?

(iv) The farmer continues ...against misuse of what kind of reserves?

(v) Hydrogeology is the study of what feature?

(b) Write a summary of the passage given above.

UNIT - II

2. Discuss the chief tenets of "Animalism" as envisioned by Old Major?

OR

Write a brief character sketch of Boxer.
3. Give a detailed description of the year 802701 AD?

OR

What kind of people were the Marlocks? Elaborate.

UNIT IV

4. Write the process of making a power point presentation.

OR

Write a report on the celebration of Sir Syed Day in your Hall.

OR

Write a report on the celebration of Eid Milad-un-Nabi in your Hall.

UNIT V

5. Read the following passage and write a précis of the same:

What is the nature of the scientific attitude, the attitude of the man or woman who studies and applies physics, biology, chemistry, geology, engineering, medicine or any other science?

We all know that science plays an important role in the societies in which we live. Many people believe, however, that our progress depends on two different aspects of science. The first of these is the application of the machines, products and systems of applied knowledge that scientists and technologists develop. Through technology, science improves the structure of society and helps man to gain increasing control over his environment. New fibres and drugs, faster and safer means of transport, new systems of applied knowledge (psychiatry, operational research etc) are some examples of this aspect of science.

The second aspect is the application by all members of society, from the government official to the ordinary citizen, of the special methods of thought and action that scientists use in their work.

First of all, it seems that a successful scientist is full of curiosity he wants to find out how and why the universe works. He usually directs his attention towards problems which he notices have no satisfactory explanation and his curiosity makes him look for underlying relationships even if the data available seem to be unconnected. Moreover, he is a good observer, accurate, patient and objective and applies persistent and logical thought to the observations he makes.

He is sceptical – he does not accept statements which are not based on the most complete evidence available and therefore rejects authority as the sole basis for truth. (approximately 262 words)

6. Rewrite the following paragraph, putting all the verbs into the Simple Past Tense:

The geochemist goes to sea in a ship equipped with special pipes. Technicians then push these pipes through thousands of feet of water until the strike the bottom of the ocean. Then they drive the pipes into the sea-bottom and when the bring them up again they are full of mud.

UNIT VI

7. Write an essay on any one of the following topics in about 300 words:

(i) Humanoids: The new species

(ii) Internet and knowledge distribution to the marginalized.
2013-16  
B.TECH. (AUTUMN SEMESTER) EXAMINATION  
ALL BRANCHES  
THERMAL SCIENCES  
ME 101

Maximum Marks: 60  
Credits: 04  
Duration: Three Hours

Answer all the questions.  
Assume suitable data if missing.  
Notations used have their usual meaning.

Q.No.  

1(a) Differentiate between:  
(i) Path function and point function  
(ii) 2-stroke and 4-stroke engine

1(b) A new scale °N of temperature is divided in such a way that the ice point is 5 °N and the steam point is 20 °N. Derive an expression between °N and °C. What is the temperature reading on this new scale when the temperature is 150°C?

1(c) A vacuum gage shows that the pressure in a closed gas chamber is 0.1 bar (vacuum). The pressure of the atmosphere is measured as 760 mm by a column of mercury. Find in bars, the absolute pressure within the chamber.

2(a) A balloon of flexible material is to be filled with air from a storage bottle until it has a volume of 0.9 m³. The atmospheric pressure is $1.013 \times 10^5$ N/m². Determine the work done by the system comprising the air initially in the bottle, given that the balloon is light and requires no stretching. Also explain what would be the effect on work done by air if the balloon is stretchable.

2(b) Air passes through a gas turbine system at the rate of 4.5 kg/s. It enters the turbine system with a velocity of 90 m/s and a specific volume of 0.35 m³/kg. It leaves the turbine system with a specific volume of 1.45 m³/kg. The exit area of the turbine system is 0.038 m². In its passage through the turbine system, the specific enthality

Contd.....2.
of the air is reduced by 200 kJ/kg and there is heat loss of 40 kJ/kg. Determine:

i. The inlet area of the turbine

ii. The exit velocity of the air

iii. The power developed by the turbine system in kilowatts.

OR

2'(a) Derive Steady Flow Energy Equation for a control volume.

2'(b) A 100 mm diameter vertical cylinder, closed by a piston, contains a combustible mixture at a temperature of 15 °C. The piston is free to move and its mass is such that the mixture pressure is \( 240 \times 10^5 \) N/m\(^2\); the upper surface of the piston is exposed to the atmosphere. The mixture is ignited. As the reaction proceeds, the piston moves slowly upwards and heat transfer to the surroundings takes place. When the reaction is complete and the temperature of the contents has been reduced to the initial value, 15 °C, it is found that the piston has moved upwards a net distance of 85 mm and that the magnitude of the heat transfer to the surroundings is 4 kJ. Evaluate the increase in the energy of the contents of the cylinder.

3(a) What are the limitations of a Throttling Calorimeter. Explain the working of a Separating and Throttling Calorimeter with the help of a property diagram.

3(b) The properties of a certain gas are related by

\[
pv = 310(t+273)
\]

and

\[
u = u_0 + 0.84t
\]

where \( p \) is in N/m\(^2\), \( v \) in m\(^3\)/kg, \( t \) in °C and \( u \) in kJ/kg.

A cylinder fitted with a piston contains 0.02 m\(^3\) of this gas at a pressure of \( 350 \times 10^5 \) N/m\(^2\) and a temperature of 80 °C. As the gas expands to a lower pressure the work done by the gas is 2900 N-m and the heat transfer from the gas is \( 10^3 \) J.

(a) Determine the temperature of the gas after expansion.

(b) If the gas undergoes an adiabatic process between the same and states, evaluate the work done by the gas in this case.

OR

3'(a) A rigid vessel contains 1 kg of a mixture of saturated water and saturated steam at a pressure of \( 140 \times 10^5 \) N/m\(^2\). When the mixture is heated, the state passes through the critical point. Evaluate:

Contd.....3.
(i) The volume of the vessel
(ii) The mass of liquid and of vapour in the vessel initially
(iii) The temperature of the contents of the vessel when the pressure has risen to $30 \times 10^8$ N/m$^2$
(iv) The heat transfer required to produce the final state (i).

3(b) Define pure substance and state 2-property rule.

4(a) Show that violation of Kelvin Planck statement leads to the violation of Clausius statement and vice-versa.

4(b) A reversible heat engine operates between two systems at constant temperatures of 600 °C and 40 °C. The engine drives a reversible refrigerator which operates between systems at constant temperatures of 40 °C and -30 °C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine-refrigerator plant is $350 \times 10^3$ N m.

(i) Evaluate the heat transfer to the refrigerant and the net heat transfer to the system at 40 °C.

(ii) Reconsider (i), given that the efficiency of the heat engine and the coefficient of performance of the refrigerator are each 40% of their respective maximum possible values.

OR

4' In a refrigerating plant, the states of the working fluid (Freon-12) between the various components are as follows.
- Evaporator and compressor: wet vapour at a temperature of -15 °C.
- Compressor and condenser: dry saturated vapour at a temperature of 30 °C.
- Condenser and expansion valve: saturated liquid at a temperature of 30 °C.
- Expansion valve and evaporator: wet vapour at a temperature of -15 °C.

The heat transfer rate from the Freon in the condenser is $1.5 \times 10^3$ J/s and the power required to compress the Freon is 310 W. All heat transfers to the atmosphere, and also fluid velocities, may be assumed to be negligible.

Sketch the cycle on an enthalpy-pressure diagram and using the data given below,
calculate:

(i) the mass flow rate of the Freon in kg/s
(ii) the heat transfer rate of the Freon from the cold region
(iii) the enthalpy of the Freon after the expansion valve
(iv) the enthalpy and dryness fraction of the Freon at the entry to the compressor
(v) the coefficient of performance

Extract from table of properties of Freon-12:

<table>
<thead>
<tr>
<th>Pressure $10^4$ N/m²</th>
<th>Saturated temperature °C</th>
<th>Specific enthalpy $10^5$ J/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1825</td>
<td>-15</td>
<td>22.3</td>
</tr>
<tr>
<td>0.745</td>
<td>30</td>
<td>64.6</td>
</tr>
</tbody>
</table>

5(a) Two water tanks are connected to each other through a mercury manometer with inclined tubes, as shown in figure. If the pressure difference between the two tanks is 20 kPa, calculate 'a' and 'Q'.

5(b) Sketch the Brayton cycle on P-V and T-S diagrams and show in the relevant diagram, the heat supplied and work done in various processes.
Q. No. 1(a) A hand truck shown in Fig. 1 is used to move two kegs, each of mass 40 kg. [8]

Neglecting the mass of the hand truck, determine (a) the vertical force \( P \) that should be applied to the handle to maintain equilibrium when \( \alpha = 35^\circ \), (b) the corresponding reaction at each of the two wheels.

![Diagram of hand truck](image)

Fig. 1

1(b) Determine the resultant of the forces shown in Fig. 2. [4]

OR

1(b)' A crate of mass 80 kg is held in the position shown in Fig. 3. Determine (a) the moment produced by the weight \( W \) of the crate about \( E \), (b) the smallest force applied at \( E \) that creates a moment of equal magnitude and opposite sense about \( E \). [4]

Contd.....2.
1' (a) The machine part ABC shown in Fig. 4 is supported by a frictionless hinge at B and a 10° wedge at C. Knowing that the coefficient of static friction at both surfaces of the wedge is 0.20, determine (a) the force P required to move the wedge, (b) the components of the corresponding reaction at B.

1' (b) Determine the vertical force P that must be applied at C to maintain the equilibrium of the linkage shown in Fig. 5.

2 The masses of blocks A, B, C and D are 9 kg, 9 kg, 6 kg and 7 kg, respectively. Knowing that a downward force of magnitude 120 N is applied to block D, determine (a) the acceleration of each block, (b) the tension in cord ABC. Neglect
the weights of the pulleys and the effect of friction (Refer Fig. 6).

3. Rod \( AB \) moves over a small wheel at \( C \) while end \( A \) moves to the right with a constant velocity of 500 mm/s. At the instant shown in Fig. 7, determine (a) the angular velocity of the rod, (b) the velocity of end \( B \) of the rod.

![Fig. 6](image)

![Fig. 7](image)

\( \text{--- SECTION-B} \)

4(a) (i) Define the following terms: Poisson's ratio, Ductility, Toughness, Britteness.

(ii) A vertical rod of 'L' m long fixed at upper end and carries an axial tensile load 'P' force. The rod tapers uniformly from diameter of 'D' at the top and 'd' at the bottom. Derive the expression for the total extension of the bar.

OR

(ii) A bar of 30 mm diameter is subjected to a pull of 60kN. The measured extension on gauge length of 200mm is 0.09 mm and change in diameter is 0.0039 mm. Calculate the Poisson's ratio, modulus of elasticity (E), modulus of rigidity (C) and bulk modulus (K).

4(b) At a point in a material under stress, the intensity of the resultant stress on a certain plane is 50 MN/m² (tensile) inclined at 30 degree to the normal of that plane. The

Contd....3.
stress on a plane at right angles to this has a normal compressive component of intensity of 30 MN/m². Find,

(i) The principal plane and stresses,

(ii) The plane of maximum shear and its intensity.

5(a) Draw the shear force and bending moment diagram for the following beam shown in Fig. 8. Also find the maximum bending moment.

![Figure 8](image1)

5'(a) Draw the shear force and bending moment diagram for the following beam shown in Fig. 9.

![Figure 9](image2)

5(b) A cast iron water main 12 meter long of 550 mm outside diameter and 25 mm wall thickness runs full of water and is supported at its ends. Calculate the maximum stress in the metal if density of cast iron is 72 kN/m³ and that of water is 10 kN/m³.