2014-2015
B.Tech. (1st Semester) Examination
(ELECTRICAL/MECHANICAL/CIVIL/CHEMICAL/ELECTRONICS/COMPUTER/PETRO-CHEMICAL ENGINEERING)
APPLIED CHEMISTRY
(AC – 111)
Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions. Marks are allotted against each question.

Q.No. Question M.M.
1(a) Give the different steps in gravimetric analysis. Explain in detail the precipitation step in gravimetric analysis. [04]
1(b) Draw a labelled curve for the titration of 100 ml of 0.1 M HCl with 0.1 M NaOH. [02]
1(c) Differentiate between the primary and secondary standards. [02]
1(d) Draw the block diagram of a single beam ultraviolet-visible spectrophotometer. [02]

OR

1'(a) Describe the different types of precipitates and impurities therein in gravimetric analysis. Explain different methods used for the minimization of impurities in precipitates. [05]

1'(b) Calculate the molar absorptivity of a solution based on the following data. Absorbance = 2.5, width of the sample holder = 1.0 cm, concentration of the solute = 4.5 g/L and molecular weight of the solute = 336. [2.5]

1'(c) Give the classification of chromatographic techniques. Explain any one of them. [2.5]

2(a) What are the requirements of water for municipal use? List the various steps involved in the treatment of municipal water. Explain disinfection step in details. [05]

2(b) Write short notes on:
(i) Chemical equations of lime with hardness causing impurities
(ii) Caustic embrittlement

OR

2'(a) A water sample, on analysis, gave the following constituents in mg/L:
MgCl₂ = 9.5, CaSO₄ = 34, CaCO₃ = 25.0, Mg(HCO₃)₂ = 73, MgSO₄ = 60.0, SiO₂ = 2.4.
Calculate the amount of lime and soda required for softening of 40,000 L of water if the cont'd...
purities of lime and soda are 85% and 95%, respectively. (The atomic weight of Mg = 24, Ca = 40, Cl = 35.5, O = 16, H = 1, C = 12, S = 32 and Si = 28)

2'(b) Write short notes on the followings:
(i) Sedimentation with coagulation
(ii) Reactions of zeolite with hardness causing impurities

3(a) What is petroleum? What are the various fractions obtained from the fractional distillation of petroleum? Mention the industrial uses of each fraction.

3(b) A coal has the following composition by weight: C = 90%; O = 3%; S = 0.5%; N = 0.5% and ash = 2.5%. Net calorific value of coal was found to be 8,490.5 Kcal/kg. Calculate the percentage of hydrogen and higher calorific value of the coal.

4(a) What is lubrication? Discuss the mechanism of thick film lubrication.

4(b) Write short notes on any three of the followings:
(i) Flash point and fire points
(ii) Viscosity and viscosity index
(iii) Saponification value
(iv) Drop point of grease

5(a) Write the mechanism of electrochemical corrosion in acidic environment.

5(b) Differentiate between any two of the followings:
(i) Galvanizing and tinning
(ii) Electrochemical series and galvanic series
(iii) Dry corrosion and wet corrosion

6(a) What are the polymers? Differentiate between addition and condensation polymers.

6(b) Discuss the mechanism of free radical addition polymerization with the help of an example.

6(c) Give the preparation, properties and uses of polytetrafluoroethylene (PTFE) or Bakelite.
2014 – 2015
B.TECH. (WINTER SEMESTER) EXAMINATION
ALL BRANCH (BACKLOG)
APPLIED MATHEMATICS – II (OLD COURSE)
(AM – 102)
Credits : 04

Maximum Marks: 60
Duration: Three Hours

Note: Answer all questions.

1. (a) Write salient features and trace the conic
   
   \[ 16x^2 - 24xy + 9y^2 - 104x - 172y + 44 = 0 \]

   (b) Find the equation of the cone with vertex at the origin and passing through the curve
   
   \[ x^2 + y^2 = 16, \quad z = 3. \]

   OR

   (b') If \(PSP'\) and \(QSQ'\) are two perpendicular focal chords of a conic, prove that \[ \frac{1}{PS \cdot PS'} + \frac{1}{QS \cdot SQ'} \] is constant.

2. (a) If \( V = (x^2 + y^2 + z^2)^{-1/2} \), show that
   
   \[ \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = 0 \]

   (b) If \( x + y = 2e^\theta \cos \phi \) and \( x - y = 2ie^\theta \sin \phi \), where \( i = \sqrt{-1} \), show that
   
   \[ \frac{\partial^2 v}{\partial \theta^2} + \frac{\partial^2 v}{\partial \phi^2} = 4xy \frac{\partial^2 v}{\partial x \partial y} \]

   OR

   (b') If \( u = xy + yz + zx, v = x^2 + y^2 + z^2, \) and \( w = x + y + z \), show that \( u, v, w \) are not independent and find the relation among them.

3. (a) Obtain Taylor's expansion of the function \( f(x, y) = e^x \cos y \) in the neighbourhood of \( \left[ 1, \frac{\pi}{2} \right] \) upto 2nd degree terms.

   (b) Prove that the rectangular solid of maximum volume which can be inscribed in a sphere is cube.
4.  (a) Find the volume in positive octant of the ellipsoid

\[ \frac{x^2}{a^2} + \frac{y^2}{b^2} + \frac{z^2}{c^2} = 1. \]

(b) Find by double integration the area lying inside the cardioid \( r = a(1 + \cos \theta) \) and outside the circle \( r = a \).

OR

(b') Evaluate the following integral by changing the order of integration

\[ \int_{0}^{1} \int_{x}^{\sqrt{1-x^2}} \frac{x \, dy \, dx}{\sqrt{x^2 + y^2}}. \]

5.  (a) Find the Fourier series to represent \( f(x) = x - x^2 \) from \( x = -\pi \) to \( x = \pi \) and show that \( \frac{\pi}{12} = \frac{1}{1^2} - \frac{1}{2^2} + \frac{1}{3^2} - \frac{1}{4^2} + \cdots. \)

(b) Find half range cosine series for the function \( f(x) = x^2 - 2 \) for \(-2 < x < 2\).
2014-15
B.TECH (AUTUMN SEMESTER) EXAMINATION
(Civil/Chemical/Computer/Electrical/Electronics/Mechanical/Petro-Chemical Engg.)
APPLIED PHYSICS-I
AP-101

Maximum Marks: 60
Credits: 03
Duration: Three Hours

Answer all the questions. Symbols used have their usual meaning.

1(a) What do you understand by effective mass? Derive an expression for effective mass and discuss its dependence on band curvature. [05]

1(b) Discuss Hall effect in the case of p-type semiconductor. Obtain an expression for majority carrier concentration in terms of measurable parameters. [06]

1(c) Si is doped with $10^{18}$ As/cm$^3$ at 300 K, where is $E_F$ with respect to $E_G$? Also find minority carrier concentration. (Given: $k_B=1.38\times10^{-23}$ J/K, $n_i=1.5\times10^{16}$ cm$^{-3}$) [04]

OR

1(c') Discuss with the help of suitable diagrams temperature dependence of carrier concentration in intrinsic and extrinsic semiconductors. [04]

2(a) What are the postulates of special relativity? Starting with proper relationship between $x$ and $x'$, obtain Lorentz transformation equations. [06]

2(b) Write down Maxwell's equations. Give a quantitative treatment of the travelling electromagnetic wave and show that $E/B$ = c. [06]

2(c) Find the mass (in GeV/c$^2$) of a particle whose total energy and momentum are 4.00 GeV and 1.45 GeV/c respectively. [03]

3(a) With the help of suitable diagram describe the construction of an x-ray tube and explain the production of i) continuous and ii) characteristic x-rays. How the presence of the minimum wavelength, $\lambda_{min}$ is explained in the x-ray spectrum? [7]

(b) An x-ray machine operates at a certain accelerating voltage such that the value of minimum wavelength, $\lambda_{min}$ produced is found to be 24.8 pm. Find the accelerating voltage applied in the tube. [3]

(c) Explain Compton effect (no derivation required) and how this effect is different from pair production? An x-ray photon whose initial frequency was $1.5\times10^{19}$ Hz emerges from a collision with an electron with a frequency of $1.2\times10^{19}$ Hz. How much kinetic energy was imparted to electron? (take $h=6.63\times10^{-34}$ J.s) [5]

OR

3'(a) Explain the term 'pair production' and show that it is not possible for the pair production to occur in free space. What nature of radiation is established by the phenomenon of pair production? [04]

3'(b) What is a group velocity? Obtain its mathematical expression and show that the group velocity, $v_g$ associated with a moving particle is equal to the velocity, $v$ of the particle itself. [07]

3'(c) State Heisenberg's uncertainty principle. If uncertainty in the position of a particle is equal to its de Broglie wavelength, show that the uncertainty in its velocity is equal to its velocity. [04]

Contd...
4 (a) What do you mean by a well behaved wave function? 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 functions and the corresponding probability densities for the two lowest quantum states.

4(b) Show that the expectation value, \( \langle x \rangle \) of the position of a particle trapped in a box L wide is independent of its quantum state, i.e., \( n \).

4(c) Estimate the probability of finding a particle in a box L wide between \( x = 0 \) and \( x = L/3 \) in its first excited state (\( n = 2 \)).

OR

4' Discuss tunnel effect quantitatively to obtain an expression for the approximate transmission probability, \( T \) of a particle of energy \( E \) through a barrier of height \( U \) such that \( E < U \).
1(a) What do you understand by direct and indirect band gap semiconductors? Draw E vs. k diagrams for aforementioned semiconductors and give five examples of semiconductors to be used in light emitting devices.

OR

1(a') Define mobility of a charge carrier. Taking into consideration contribution of electrons and holes, derive an expression for electrical conductivity of a semiconductor.

1(b) Calculate effective densities of states $N_e$ and $N_v$ for GaAs at 300 K (assume $m^*_n$ and $m^*_p$ do not vary with temperature). Also calculate intrinsic carrier concentration and compare with the given $n_i$.

\[ \text{Given: } m^*_n = 0.067 m_e, m^*_p = 0.48 m_e, n_i = 2 \times 10^{16} \text{ cm}^{-3} \text{ and } E_g = 1.43 \text{ eV} \]

2(a) What is the basic principle of optical fiber communication? Taking into account step index fiber, obtain an expression for angle of acceptance hence write expression for numerical aperture.

2(b) Categorize optical fibers on the basis of refractive index profile. Draw diagrams showing light propagation in these fibers.

2(c) The core and cladding of silica fiber have refractive indices 1.473 and 1.458 respectively. Calculate (i) critical angle of reflection for core cladding boundary, (ii) acceptance angle for fiber and (iii) numerical aperture.

3(a) Define stimulated emission. Discuss construction and working of a ruby laser with the help of suitable diagrams. Also point out some of the drawbacks of ruby laser.

OR

3(a') Discuss construction and working of a four level laser. Compare this laser with ruby laser.

3(b) A typical ruby laser emits radiation of 6943 Å because of transition between the energy levels of Cr$^{3+}$ ions. If ruby is 7 cm long 0.8 cm in diameter contains $10^{19}$ Cr$^{3+}$ ions/cm$^3$. What is the maximum energy of a pulse radiation emitted by this ruby laser? If pulse lasts for $5 \times 10^{-9}$ sec, what is average power of the laser during the pulse?

OR

3(c') Discuss the applications of laser in holography and isotope separation.
4 What is Compton effect? Give complete quantitative treatment to obtain Compton shift in wavelength.
A beam of x-rays is scattered by free electrons. At 45° from the beam direction the scattered x-rays have wavelength of 0.022 Å. What is wavelength of the incident beam?

OR

4' Explain pair production and pair annihilation. Show that pair production cannot take place in free space.
A 1.0 MeV positron collides with an electron at rest and the two particles are annihilated. Two photons are produced; one moves in the same direction as the incident positron and the other moves in the opposite direction. Determine the energies of the two photons (Assume rest mass energy of an electron or a positron to be 0.51 MeV).

5(a) Discuss physical significance of a wave function? Obtain the time dependent form of Schrodinger equation.

5(b) Find the probability that a particle trapped in a box L wide can be found between 0.45L and 0.55L for the ground and first exited states.

6(a) What is statistical mechanics? Derive an expression for molecular energy distribution, n(e)de in an ideal gas. Use this distribution to show that average energy of ideal gas molecules is 3kT/2.

6(b) Find the most probable, average and rms speeds of oxygen molecules at 20°C.

OR

6(a') Discuss Dulong-Petit law for specific heat of solids and mention its failure. Obtain Einstein’s formula for specific heat of solids.

6(b') The Fermi energy in silver is 5.51 eV. Estimate the average energy of free electrons in silver at 0 K. What temperature is necessary for the ideal gas molecules to acquire this value of average energy?

Some useful physical constants
\[h=6.63\times10^{-34} \text{ J.s,} \quad k_B=1.38\times10^{-23} \text{ J/K,}\]
\[m_e=9.1\times10^{-31} \text{ kg,} \quad m_p=1.67\times10^{-27} \text{ kg,} \quad m(O_2)=32 \text{ amu,} \quad c=3\times10^8 \text{ m/s}\]
\[n_i(Si)=1.5\times10^{16} \text{ m}^{-3}, \quad q_e=1.6\times10^{-19} \text{ C,} \quad 1 \text{ amu} = 1.66 \times 10^{-27} \text{ Kg}\]
2014-15  
B.A.R.C.H. FIRST SEMESTER EXAMINATION  
ARCHITECTURAL DRAWING - I  
AR-103

Maximum Marks: 40  
Credits: 04  
Duration: Three Hours

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

Q.No.  

1  
Represent the followings:-  
   a) A school bus in side elevation.  
   b) A palm tree in elevation.  
   c) Any two different kind of textures (in box size 80 mm X 60 mm)

   3  3  4

2  
A hexagonal prism, base 30 mm side and height 65 mm has its axis inclined at  
45° to the HP and has an edge of its base on the HP and inclined at 30° to VP.  
Draw its orthographic projections.

   10

OR

2' A hexagonal pyramid, base 30 mm side and height 60 mm, has one of its slant edges  
on ground. A plane containing that edge and the longitudinal axis is perpendicular to  
the HP and inclined at 45° to the VP. Draw its orthographic projections.

   10

3  
A cylinder of base diameter 50 mm and height 50 mm is resting on ground on its  
base. It is being cut by a plane in such a way that in elevation it appears as two equal  
right angle triangles of base 50 mm and height 50 mm. Draw the development of  
lateral surface of bottom part of truncated cylinder.

   10

Contd...2.
4. Draw isometric view of the object shown in figure - 1.

PLAN AND ALL ELEVATIONS
(All Dimensions are in mm)

FIGURE - 1
2014-15
B.Arch. (Autumn Semester) Examination
B. Arch 1-Year
Principles & Philosophy of Architecture
AR-112

Maximum Marks: 60 Credits: 04 Duration: Three Hours

Answer all the questions.
Draw sketches to support your answer.

Q.No. | Question | M.M.
--- | --- | ---
1 | Define the term architecture, how it is both art and science as discipline? | [10]

OR

1' | What are the qualities required for being a good Architect? | [10]

2 | Explain with neat sketch the basic Principles of Architectural Design? | [10]

3 | What are the indispensable elements of architectural design, explain how different planes are employed in any architectural symphony? | [10]

4 | How history as a subject is important in Architecture, explain with neat sketches? | [15]

5 | What are the various elements Laurie Baker used in his buildings, explain his philosophy and important works with neat sketches? | [15]

OR

5' | Explain the philosophy of Louis I Kahn and define with neat sketch the elements used by him in IIM Ahmedabad? |
Q.No.          Question                                      M.M.
1(a)  Describe energy and nutrient flow in an ecosystem?   [04]

OR

1'(a) Briefly describe the significance of biological magnification of pollutants through food chain. Illustrate with an example. [04]

1(b) What reactions are responsible for the formation of photochemical smog? [02]
1(c) Define ecosystem. List biotic and abiotic components of a pond ecosystem [04]
2(a) Briefly describe the effects of carbon monoxide and SO$_2$ on human health [04]
2(b) Determine the effective height of a stack, given the following data: [04]
   (i) Physical stack is 180 m tall with a 0.95 m inside diameter
   (ii) Wind velocity is 2.75 m/s
   (iii) Air temperature is 20°C
   (iv) Barometric pressure is 1000 millibars
   (v) Stack gas velocity is 11.12 m/s
   (vi) Stack gas temperature is 160°C

OR

2'(b) Briefly describe the working of any two equipments used for particulate control [04]
2'(c) Define dry adiabatic lapse rate and briefly explain its significance on atmospheric stability. [02]

3(a) What are the various ways of expressing the strength of a solution? Briefly explain [04]
3(b) Describe nitrogen cycle and explain its significance in environmental engineering.

3(c) Define persistent organic pollutants and name the important persistent organic pollutants found in environment.

4(a) Briefly describe the chemical water quality parameters of concern to human health.

4(b) What is the difference between coagulation and flocculation? Briefly describe the mechanisms of coagulation.

4(c) What happens when wastewater is discharged to a river?

5(a) Explain the significance of COD test over BOD test? An analysis for BOD₅ is to be run on a sample of wastewater. The BOD is expected to range from 50 to 350, and dilutions are prepared accordingly. In each case, a standard 300 ml BOD bottle is used. The data are recorded below:

<table>
<thead>
<tr>
<th>Bottle No</th>
<th>Wastewater (ml)</th>
<th>DO₅</th>
<th>DO₅</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>20</td>
<td>8.9</td>
<td>1.5</td>
</tr>
<tr>
<td>2.</td>
<td>10</td>
<td>9.1</td>
<td>2.5</td>
</tr>
<tr>
<td>3.</td>
<td>5</td>
<td>9.2</td>
<td>5.8</td>
</tr>
<tr>
<td>4.</td>
<td>2</td>
<td>9.2</td>
<td>7.5</td>
</tr>
</tbody>
</table>

Find the average BOD₅ of the wastewater.

5(b) Briefly describe the BOD removal mechanism in stabilization Ponds.

5(c) Draw growth curve of microorganisms under limited substrate conditions and explain each phase.

OR

5'(e) Design a rectangular primary clarifier for the treatment of 15 MLD of sewage. Assume surface overflow rate as 30 m³/m².d.

6(a) Describe the sources of municipal solid waste.

6(b) Describe the flow diagram of solid waste management and write the different functional elements.

6(c) Briefly describe the composting method of disposal of solid waste.

OR

6'(c) Explain the parameters used for characterization of solid waste.
Maximum Marks: 60
Credits: 03
Duration: Three Hours

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

<table>
<thead>
<tr>
<th>Q.No.</th>
<th>Questions</th>
<th>M.M</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(a)</td>
<td>Define apparent power, active and reactive power as related to ac circuits. Also prove that the active power in a pure inductance is zero.</td>
<td>[06]</td>
</tr>
</tbody>
</table>
| 1(b)  | An alternating voltage (80+j60) V is applied to a circuit and the current flowing is (-4+j10) A. Find:  
  a. The impedance of the circuit  
  b. Power factor  
  c. Power consumed | [06] |

**OR**

1'(a) Using phasor diagram, obtain the relationship for line and phase current for delta connected system. | [06] |
1'(b) Determine the voltage across the 2Ω resistor in figure 1 by using Norton’s theorem. | [06] |

![Figure 1](image)

2(a) A 100kVA, single phase, 1100/220 V, 60 Hz transformer has a high voltage resistance of 0.1Ω and a leakage reactance of 0.3 Ω. The low voltage winding resistance is 0.004 Ω and the leakage reactance of is 0.012 Ω. Determine the equivalent winding resistance and reactance referred to the low voltage side. | [06] |
2(b) What are the differences and similarities between electrical & magnetic circuits? | [06] |

**OR**

2' An inductor has a core built up of stampings of the shape shown in figure 2, the coil being on the central limb. There is a 1 mm air-gap in the centre limb which has a cross-sectional area of 4 cm². All other paths in the core have a cross-section area of 2 cm². The mean path lengths of the magnetic flux in each portion of the core are as shown in the figure. If the relative permeability of the iron is 800, find the current needed in the coil of 500 turns to produce a total flux in the air-gap of 0.8mWb. | [12] |
3(a) Explain the production of rotating magnetic field in a three phase induction motor. [04]
3(b) Discuss the principle of operation of a three-phase alternator. [04]
3(c) Why a single-phase induction motor is not self starting? [04]

4(a) With the help of a suitable diagram explain the construction and principle of operation of a moving iron (MI) instrument. [06]
4(b) Describe with a neat diagram the functioning of induction type single phase energy meter. [06]

5(a) Discuss the function of the following equipment in a steam power station: Condenser, cooling towers, feed water heater and economiser. [06]
5(b) How can hydroelectric power plants be classified according to: (i) water flow regulation; (ii) head; (iii) load and (iv) plant capacity.
Also Discuss the factors affecting the site selection for a hydro power project.

OR

5'(a) Write short note on solar photovoltaic power plant. [05]
5'(b) With the help of a neat block diagram explain the functioning of coal fired thermal power plant. Also explain the function of Superheater. [07]
PART A

Q. No. M.M

1(a) Using phasor diagram, obtain the relationship for line and phase current for delta connected system. [05]

1(b) Determine the current I in the network in figure 1 by Thevenin's theorem. [05]

![Figure 1](image-url)

1(c) A 100kVA, single phase, 1100/220 V, 60 Hz transformer has a high voltage resistance of 0.1Ω and a leakage reactance of 0.3 Ω. The low voltage winding resistance is 0.004 Ω and the leakage reactance of is 0.012 Ω. Determine the equivalent winding resistance and reactance referred to the high voltage side.

OR

1'(a) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full load of 500 W. Determine the efficiency at 75% full load and the maximum efficiency.
1'(h) What are different types of magnetic losses? How can they be minimized?
1'(c) In the network shown in figure 2 determine a) total impedance; b) total current, I; c) overall power factor; d) active power and d) Reactive volt-amperes.

![Figure 2](image)

2(a) With the help of a suitable diagram explain the construction and principle of operation of a permanent magnet moving coil (PMMC) instrument.

2(b) How can hydroelectric power plants be classified according to: (i) water flow regulation; (ii) head; (iii) load and (iv) plant capacity.

Also Discuss the factors affecting the site selection for a hydro power project.

2(c) What is the principle of operation of split phase motor? Draw neat sketch and phasor diagram of split phase motor.

PART B

3(a) Explain terminal characteristics of p-n junction diode in forward and reverse bias regions.

3(b) Explain the following terms:

(i) Peak inverse voltage and Zener breakdown phenomenon

(ii) Virtual short in operational amplifier

(iii) Diffusion and drift current

OR

3'(b) Design the circuit shown below (in figure 3) to provide an output voltage of 2.4V. Assume that the diodes available have 0.7V drop at 1mA and that ΔV=0.1V/decade change in current.

Contd...
4(a) Differentiate between Enhancement type and Depletion type N-channel MOSFET. Also draw $i_D-v_{GS}$ (saturation) and $i_D-v_{DS}$ characteristics with proper labelling for both types of MOSFETs.

4(b) Explain the functioning of OPAMP-based inverting integrator.

4(c) Derive an expression for the voltage gain, $V_o/V_i$ for the circuit shown in figure 4:

![Figure 4](image)

**OR**

4'(c) Explain the function of operational amplifier-based weighted summer. Design a weighted summer using two opamps and resistors that implements the following function:

$$v_0 = v_1 + v_2 - 3v_3 - 4v_4$$
Experiments have shown that in selecting personnel for a job, interviewing is at least a hindrance and may even cause harm. These studies have disclosed that the judgments of interviewers differ markedly and bear little or no relationship to the adequacy of job applicants. Of the many reasons why this should be the case, three in particular stand out. The first reason is related to an error of judgment known as the halo effect. If a person has one noticeable good trait, their other characteristics will be judged as better than they really are. Thus, an individual who dresses smartly and shows self-confidence is likely to be judged capable of doing a job well regardless of his or her real ability. The halo effect is essentially the same error, but focuses on one particular trait. Here the individual will be judged as incapable of doing a good job.

Interviewers are also prejudiced by an effect called the primacy effect. This error occurs when interpretation of information is distorted by earlier connected information. Hence, in an interview situation, the interviewer spends most of the interview trying to confirm the impression given by the candidate in the first few moments. Studies have repeatedly demonstrated that such an impression is unrelated to the aptitude of the applicant.

The phenomenon known as the contrast effect also skews the judgment of interviewers. A suitable candidate may be underestimated because he or she contrasts with a previous one who appears exceptionally intelligent. Likewise, an average candidate who is preceded by one who gives a weak showing may be judged as more suitable than he or she really is.

Since interviews as a form of personnel selection have been shown to be inadequate, other selection procedures have been devised that more accurately predict candidate suitability. Of the various tests devised, the predictor that appears to do this most successfully is cognitive ability as measured by a variety of verbal and spatial tests.

(i) What does the author mean by the phrase "essentially the same error"?
(a) The effect of the error is the same
(b) The error is based on the same kind of misjudgement.
(c) The effect focuses only on negative traits.
(d) The individual is considered less capable of the job.

(ii) Explain the primacy effect in an interview.

(iii) In addition to the interview as a selection procedure, what other ways have been devised?

(iv) Give synonyms for the following words:
hindrance, trait, prejudice, disclose

(v) According to the passage, what kind of a person has better chances of being selected based on interview as a selection procedure?

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

UNIT-II

2. What were the Seven Commandments that the Old Major had set for the Animal Farm at the beginning of the novel?

OR

Give a brief character sketch of Napoleon.

3. What is the author's philosophical view of the future and of the direction which humanity will eventually take in The Time Machine?
What kind of people were the Elxis? What was their life like?

UNIT III

4. Read the passage and answer the question that follows:

Technology is available to exploit the potential energy formed by tides for the generation of electrical energy. The basic structure is a barrage or dam built across a river estuary or at the mouth of a bay. This dam is similar to that used in hydroelectric power plants built across flowing rivers. At regular intervals along the dam, gates and turbines are installed. When the tide is rising, the gates are opened. This allows water to flow into the area behind the barrage, raising the water level there. When the water has reached its highest level, the gates are closed. Then the tides drop on the seaward side, and this trapped water is several meters above the sea level. The gates are then opened, allowing the water to discharge out. The force of the flow turns the turbines and generates electricity. It is also possible to use tidal energy when the water flows in the other direction—through the gates into the estuary from the sea.

In this way, four periods of energy production are possible every day, since coastal regions experience two high and two low tides in just over 24 hours. In order for practical amounts of electricity to be generated, the difference between high and low tides must be at least five meters. Tidal power is renewable, non-polluting, and contributes no greenhouse gases to the atmosphere. This kind of system can provide a useful energy supplement to other sources in an era of diminishing fossil fuel reserves.

Make notes of the passage given above.

OR

Write the process of making a power point presentation.

UNIT IV

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

People are questioning the addition of fluoride to water since studies have shown that it may lead to potential health hazards.

Fluoride exists in different quantities in our water supplies. Early studies showed that it was important for the development and health of teeth. According to these studies fluoride improved the enamel of developing teeth so that teeth were stronger, acid resistant, and helped the body rebuild damaged enamel.

Without people giving their consent, fluoride was added to the water in some areas where the amounts were low. However, new studies do not show a difference between the development of healthy teeth in areas of low and high amounts of fluoride in the water. The extra fluoride in the water may actually harm the environment. Also, it has been shown to accumulate in people’s bodies and cause side effects.

People should not allow themselves to be guinea pigs in a fluoride experiment, and fluoride supplements should not be added to water or toothpaste.

Fluoride should not be added to water like the dentists said that it should in the 1930s studies. It has been found that the teeth of children in areas where there is little fluoride in the water are no different than those of children in areas where there is a lot of fluoride in the water. So, the results of the early studies are wrong.

Not only does fluoride not do all the things that it supposedly does, like reduce the solubility of tooth enamel and stop plaque organisms from making acids that break down enamel, but it also causes problems in the water supply, like a poisonous waste in water. It can also cause side effects in animals, but I don’t think animals should be used in testing experiments and neither should people. People should be able to say if they want to have fluoride in their water.

In conclusion, our governments should not allow fluoride to be added to our water supply cause it is bad for us.

(Approx 250 words)
UNIT-V

6. Complete the following by choosing the appropriate words from the given list:
   The mathematics to which our _____ are exposed at school is, with rare _____, based on the classical yes-or-no, right-or-wrong _____ of logic. It normally doesn’t include one word about _____ as a mode of reasoning or as a basis for _____ several alternative conclusions.
   (exceptions, probability, youngsters, comparing, logic)

7. Write an essay on any one of the following topics in about 300 words:
   (i) The future of Engineering
   (ii) Television as a medium of education.
Maximum Marks: 60
Duration: Three Hours

Answer all questions
Draw suitable diagrams, wherever necessary
Assume suitable data, wherever necessary
Use of steam table is allowed

1(a) Define property, state, path and process. [04]
1(b) With the help of any suitable thermodynamic diagram explain why a quasi-static process only can be shown on it by a line or a curve. [04]
1(c) A U-tube mercury manometer with one arm open to atmosphere is used to measure pressure in a steam pipe. The level of mercury in open arm is 97.5 mm greater than that in the arm connected to the pipe. Some of steam in the pipe condenses in the manometer arm connected to the pipe. The height of this column is 34 mm. The atmospheric pressure is 760 mm of Hg. Find the absolute pressure of steam in bar. [04]

2(a) A gas in a closed system expands in a quasi-equilibrium process from a volume of 0.20 m$^3$ at 200 kPa, 80°C to a volume of 0.60 m$^3$ in such a manner that $p = 225-125V$, where $p$ in kPa and $V$ in m$^3$. How much work is done? [05]
2(b) A system consisting of a mixture of air and gasoline vapour at an initial temperature of 15°C is contained in a rigid vessel. The mixture undergoes the following processes in sequence.
(i) The mixture temperature is raised to 200°C by a heat transfer of +3 kJ.
(ii) The mixture is ignited and burns completely; this process is adiabatic and temperature rises to 1500°C.
(iii) The temperature of the product of combustion is reduced to 120°C by a heat transfer of -32 kJ.
Evaluate the energy of the system after each process given that the initial energy of the system is 10 kJ.

OR
2'(a) A mass of two kilograms of water at a temperature of 18°C is poured into an insulated copper vessel which initially is at a temperature of 15°C. When the temperatures have equalized, the water is at a temperature of 17.4°C. Determine the magnitude and sign of the heat transfer for each of the following three systems:

(i) The vessel and the insulation
(ii) The water
(iii) The vessel and the insulation plus the water.

2'(b) In a water cooling tower air enters at a height of 1 m above the ground level and leaves at a height of 7 m. The inlet and outlet velocities are 20 m/s and 30 m/s respectively. Water enters at a height of 8 m and leaves at a height of 0.8 m. The velocity of water at entry and exit are 3 m/s and 1 m/s respectively. Water temperatures are 80°C and 50°C at the entry and exit respectively. Air temperatures are 30°C and 70°C at the entry and exit respectively. The cooling tower is well insulated and a fan of 2.25 kW drives the air through the cooling tower. Find the air required in kg per kg of water flow. Use Δh = C_p Δt and C_p of air as 1.005 kJ/kg K and for water as 4.187 kJ/kg K.

3(a) State two property rules and sketch a neat p–h diagram for a simple compressible substance showing clearly all the regions, boundaries and significant points.

3(b) A pure substance is contained in a cylinder closed by a piston. The substance undergoes a fully-resisted, constant pressure process in which the only work done is the displacement work at the slowly-moving piston face. Show that the heat transfer during the process is equal to the increase in the enthalpy of the substance.

OR

3'(a) Find the enthalpy and entropy of steam when the pressure is 2 MPa and the specific volume is 0.09 m³/kg.

3'(b) A vertical cylinder, fitted with a frictionless leak-proof piston contains 0.03 kg of dry saturated steam. The upper face of the piston is exposed to the atmosphere; the weight of the piston is such that the steam pressure is 300 kN/m². A quantity of saturated water at the same pressure is introduced into the cylinder and mixes thoroughly with the steam. When the mixture is heated subsequently, with the piston held stationary, its state passes through the critical point. Find the mass of water introduced.
4. State Kelvin-Planck and Clausius statements of second law of thermodynamics and prove their equivalence.

OR

4' In a refrigerating plant shown in figure 1 the states of the working fluid (Freon-12) between the various component are as follows:
State 1: Wet vapour at -15°C; State 2: Dry saturated vapour at 30°C; State 3: saturated liquid at 30°C; State 4: Wet vapour at -15°C.

The heat transfer from condenser q₁ = 1.5 kW and compressor power requirement is 310 W. All heat transfers to the atmosphere, and also fluid velocities may be assumed to be negligible. Sketch the cycle on p-h diagram and using the given data calculate:
(i) Mass flow rate of Freon in kg/s.
(ii) The heat transfer rate q₂ from the cold region.
(iii) The enthalpy after expansion valve.
(iv) The enthalpy and dryness fraction at compressor entry.
(v) The COP.

Properties of Freon-12

<table>
<thead>
<tr>
<th>Pressure, MPa</th>
<th>Saturation Temperature, °C</th>
<th>Specific Enthalpy, kJ/kg</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Saturated liquid</td>
</tr>
<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) A reversible heat engine operates between two systems at constant temperatures of 600°C and 40°C. The engine derives a reversible refrigerator which operates between system at constant temperature of 40°C and -20°C. The heat transfer to the heat engine is 2000 kJ and the net work output of the combined engine-refrigerator plant is 350 x 10³ Nm. Evaluate the heat transfer to the refrigerant and net heat transfer to the system at 40°C.

5(b) State thermodynamic definition of positive work and prove its superiority by applying to an electric battery discharging through a resistor.
Maximum Marks: 40  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  Assuming a suitable length of scale, construct a diagonal scale of R.F. = 1/40 to read  [08]
    upto a single centimeter. Indicate the following distances on the scale
    (a) 3.57 meter  (b) 5.42 meter

2  A line PQ 80 mm long has its end P is in H.P. and 45 mm infront of V.P. The line is  [10]
    inclined at 45° to the H.P. The end Q is in V.P. Draw the projections of the line and
    find the true inclination with H.P. and P.P.

3  The pictorial view of a machine part is shown in figure 1. Draw the following views  [12]
    with first angle projection method.
    (a) Elevation  (b) Plan  (c) Left end view

    OR

3'  A casting of V- block with quarter portion removed is shown in figure 2. Draw the  [12]
    following views.
    (a) Half sectional elevation
    (b) Half sectional left end view
    (c) Plan

4  The orthographic views of an object are shown in figure 3. Draw the isometric  [10]
    projection of the object along with a suitable isometric scale.
    OR

4'  Develop the lateral surface of the square prism shown in figure 4 having cut in it.  [10]
    Open the square prism at the given seam.

contd...
B.TECH. (AUTUMN SEMESTER) EXAMINATION
MECHANICAL ENGINEERING
ENGINEERING MECHANICS
ME 103

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

1 Answer any two of the following.

a) Two forces P and Q are applied as shown in figure 1(a) to an aircraft connection. Knowing that the connection is in equilibrium and that P = 500 N and Q = 650 N, determine the magnitudes of the forces exerted on the rods A and B.

b) The lever BCD is hinged at C as shown in figure 1(b) and attached to a control rod at B. Determine the maximum force P which can be safely applied at D if the maximum allowable value of the reaction at C is 1000 N.

c) Two $10^0$ wedges of negligible weight are used to move and position the 163 kg block. Knowing that the coefficient of the static friction at all surfaces of contact is 0.25, determine the smallest force P that should be applied as shown in figure 1(c) to one of the edges.

2 Answer any two of the following.

a) For the plane area shown in figure 2(a), determine
   i) The first moments with respect to the x and y axes.
   ii) The location of the centroid.

b) Determine the moment of inertia of the shaded area shown in figure 2(b), with respect to each of the coordinate axes.

c) A thin semielliptical plate shown in figure 2(c) has a mass ‘m’ determine the mass moment of inertia of the plate with respect to (i) the centroidal axis BB’ (ii) the centroidal axis CC’ that is perpendicular to the plate.

3 Answer any two of the following.

a) Slider block B, shown in figure 3(a), moves to the right with a constant velocity of 300 mm/s. Determine
   i) The velocity of slider block A
   ii) The velocity of portion C of the cable
   iii) The velocity of portion D of the cable
   iv) The relative velocity of portion C of the cable with respect to slider block A

Contd... 2.
b) The nozzle at A, shown in figure 3(b), discharges cooling water with an initial velocity \( V_0 \) at an angle of 6° with the horizontal onto a grinding wheel 350 mm in diameter. Determine the range of values of the initial velocity for which the water will land on the grinding wheel between points B and C.

c) The rotation of the rod OA about O, as shown in figure 3(c) is defined by the relation \( \theta = \pi \left( 4t^2 - 8t \right) \), where \( \theta \) and \( t \) are expressed in radians and seconds respectively. Collar B slides along the rod so that its distance from O is \( r = 10 + 6 \sin \pi t \) where \( r \) is in millimeter. When \( t = 1 \), determine

i) The velocity of the collar.
ii) The total acceleration of the collar
iii) The acceleration of the collar relative to the rod.

4(a) The 20 kg block B is suspended from a 2 m chord attached to the 30 kg cart A which can roll freely on a frictionless horizontal track, as shown in figure 4(a). If the system is released from rest when \( \theta = 35^\circ \), determine the velocities of A and B when \( \theta = 0 \).

4(b) An 80 kg man and a 60 kg woman stand at opposite ends of a 130 kg boat, ready to dive, each with a 5 m/s velocity relative to the boat. Determine the velocity of the boat after they have both dived, if

(i) The woman diverges first
(ii) The man diverges first

5 Answer any two of the following.

a) In the engine system shown in figure 5(a), \( l = 160 \) mm and \( b = 60 \) mm. Knowing that the crank AB rotates with a constant angular velocity of 1000 r/min clockwise, determine the velocity of the piston P and the angular velocity of the connecting rod when (i) \( \theta = 0 \)
(ii) \( \theta = 90^\circ \).

b) A uniform rectangular plate has a mass of 5 kg and is held in position by three ropes as shown in figure 5(b). Knowing that \( \theta = 30^\circ \), determine immediately after rope CF has been cut, (i) the acceleration of the plate (ii) the tension in ropes AD and BE.

c) Each the gears A and B has a mass of 2.4 kg and a radius of gyration of 60 mm, while gear C has a mass of 12 kg and a radius of gyration of 150 mm as shown in figure 5(c). A couple \( M \) of constant magnitude 10 Nm is applied to gear C. Determine

i) The number of revolutions of gear C required for its angular velocity to increase from 100 to 450 r/min.
ii) The corresponding tangential force acting on gear A.

d) The double pulley shown in figure 5(d) weighs 13.6 kg and has a centroidal radius of gyration of 165 mm. Cylinder A and block B are attached to cords that are wrapped on the pulleys as shown. The coefficient of kinetic friction between block B and the surfaces is 0.25. Knowing that the system is released from rest in the position shown, determine

i) The velocity of cylinder A as it strikes the ground.
ii) The total distance that block B moves before coming to rest.
Fig. 5(a)

Fig. 5(b)

Fig. 5(c)

Fig. 5(d)
SECTION A

Q.No. Question

1. (a) Collars A and B are connected by a 1-m-long wire and can slide freely on frictionless rods (Figure-1). If a force $P = (680 \text{ N})\hat{j}$ is applied at A, determine

(a) the tension in the wire when $y = 300 \text{ mm}$, (b) the magnitude of the force $Q$ required to maintain the equilibrium of the system.

![Figure-1](path_to_image)

OR

Contd... 2
1. (a') Three cables are used to tether a balloon as shown (Figure-2). Determine the vertical force \( P \) exerted by the balloon at \( A \) knowing that the tension in cable \( AB \) is 259 N.

![Figure-2](image)

1. (b) The coefficients of friction are \( \mu_s = 0.40 \) and \( \mu_k = 0.30 \) between all surfaces of contact. Determine the force \( P \) for which motion of the 30-kg block is impending if cable \( AB \) is attached as shown in Figure-3.

![Figure-3](image)

OR

1. (b') Determine the vertical force \( P \) which must be applied at \( G \) so that the linkage is in equilibrium for the position shown. (Figure-4)
2. (a) The 18 kg block starts from rest and moves upward when constant forces of 20 N and 40 N are applied to supporting ropes (Figure-5). Neglecting the masses of the pulleys and the effect of friction, determine the speed of the block after it has moved 0.457 m.

![Figure-4](image)

2. (b) A 1.8 kg collar can slide without friction along a horizontal rod and is in equilibrium at A when it is pushed 25 mm to the right and released from rest (Figure-6). The springs are undeformed when the collar is at A and the constant of each spring is 490 kN/m. Determine the maximum velocity of the collar.

![Figure-5](image)
3.(a) The bent rod $ABCD$ rotates about a line joining points $A$ and $D$ with a constant angular velocity of 75 rad/s. Knowing that at the instant considered the velocity of corner $C$ is upward, determine the velocity and acceleration of corner $B$. (Figure-7)

3.(a') The angular acceleration of a flywheel is defined by the relation $\alpha = 30e^{-0.2t}$, where $\alpha$ and $t$ are expressed in rad/s$^2$ and seconds, respectively. Knowing that $\theta = 0$ and $\omega = 0$ at $t = 0$, determine the angular velocity and angular coordinate of the particle when $t = 0.5$ s.

3.(b) The motion of rod $AB$ is guided by pins attached at $A$ and $B$ which slide in the slots shown (Figure-8). At the instant shown, $\theta = 40^\circ$ and the pin at $B$ moves upward to the left with a constant velocity of 150 mm/s. Determine (a) the angular velocity of the rod, (b) the velocity of the pin at end $A$. 

Cont'd...
SECTION B

4. Determine the stresses in each rod of a composite section due to a compressive load of 2000 N and a temperature increase by 60 °C. The composite section has two copper rods and one steel rod. Take length of each rod as 1000 mm. Diameter of each copper rod is 300 mm and the steel rod is 200 mm.

\[ E_S = 2 \times 10^5 \text{ N/mm}^2, \quad E_{Cu} = 1 \times 10^5 \text{ N/mm}^2 \]

\[ \alpha_S = 6 \times 10^{-6} / ^\circ\text{C}, \quad \alpha_{Cu} = 11 \times 10^{-6} / ^\circ\text{C} \]

The composite section has collars at both sides.

OR

4'. Determine the total volumetric strain in a cube of side 800 mm due to the following loads.

Load along the length = 1500 N (Tensile)
Load along the thickness = 500 N (Compressive)
Load along the width = 500 N (Tensile)

Take \( E = 2 \times 10^5 \text{ N/mm}^2 \) and Poisson's ratio = 0.3

5.(a) Determine the shear force and bending moment in a simply supported beam of span 8 m with a central point load of 5 kN and u.d.l. of intensity 2 kN/m over the whole span. Draw SFD and BMD.

5.(b) Determine the bending stress and shear stress in a beam of rectangular cross-section as per following data:

Width of the section = 500 mm
Depth of the section = 1000 mm
Max. B.M. = 5.25 x 10^7 N-mm
Max. S.F. = 1.8 x 10^4 N