B.TECH. AUTUMN (I SEMESTER) EXAMINATION
(ELECTRICAL / MECHANICAL / CIVIL / CHEMICAL / ELECTRONICS /
COMPUTER / PETRO-CHEMICAL ENGINEERING)
APPLIED CHEMISTRY – I
(AC – 101)
Credits: 03

Maximum Marks : 60

Note: Answer all the questions. All questions carry equal marks.

1. (a) Describe the favourable conditions for precipitation. What is super saturation?
(b) Classify volumetric analysis with examples. Explain the terms standardization, primary standards and secondary standards.

2. (a) What is the basic principle of spectrophotometry? State Beer Lambert’s Law and explain the terms involved.
(b) Classify chromatography on the basis of physical mode and mechanism.

OR

2. (a) Draw a labelled diagram of a single beam spectrophotometer and mention the function of various components.
(b) Define the followings.
(i) Stationary and mobile phase.
(ii) Retention Factor
(iii) Resolution

3. (a) How air pollutants are classified on the basis of origin, chemical composition and state of matter?
(b) Discuss the sources and harmful effects of carbon monoxide in the atmosphere.

4. (a) Explain the terms phase, component and degree of freedom.
(b) Draw a phase diagram of water system and explain its important features.

5. (a) What is natural rubber? Describe the vulcanization of natural rubber and mention its advantages.
(b) Describe the preparation, properties and uses of any two of the followings:
(i) polyethylene (ii) polystyrene (iii) Teflon

6. (a) Define ceramics and classify them with suitable examples.
(b) Explain the properties and composition of some important types of glasses.

Duration : Three Hours
Maximum Marks: 60

Duration: Three Hours

Note: Answer all the questions. All questions carry equal marks.

1. (a) Give the different steps of gravimetric analysis. With the help of examples, describe the different types of precipitates formed in gravimetric analysis. [05]

   (b) List the different types of titrations and give one example of each type. What is the difference between idimetric and iodometric titrations? [05]

   OR

1'. (a) What are the applications of chromatography? Write the chemical reactions involved in the softening of water by ion exchange method. [03]

   (b) Draw a labelled diagram for the titration of 50ml of 0.01 M HCl with 0.01M NaOH. [03]

   (c) Calculate the molar absorptivity of 0.05M solution of coloured substance found to transmit 80% of light when tested by spectrophotometer using a tube of 1.0 cm path length. [04]

2. (a) List the different steps involved in the water treatment process for municipal supply. Explain the coagulation step. [03]

   (b) Describe the scale and sludge formation in boilers and methods of their prevention. [03]

   (c) A sample of water was found to contain 300 mg/l Ca\((\text{HCO}_3)\)_2, 40.0 mg/l Mg\((\text{HCO}_3)\)_2, 10.0 mg/l Mg SO4, 25.0 mg/l CaSO4 and 15.0 mg/l CaCl2. Calculate the temporary, permanent and total hardness of the water sample. Atomic weights of Mg = 24, Ca = 40, Cl = 35.5, S = 32, O = 16, H = 1 and C = 12. [04]

   OR

2'. (a) What is break point chlorination. Give its significance. [04]

   (b) Explain any one method of removal of hardness for boiler feed water. [03]

   (c) Write the chemical reactions for the following:

   (i) Hardness causing impurities and Soap

   (ii) Hardness causing impurities and EDTA

Contd..... 2
3. (a) Define the higher and lower calorific values of a chemical fuel. [03]
(b) What are the advantages and disadvantages of volatile matter present in a coal sample. [03]
(c) Draw labelled diagram of Bergius process for production of synthetic petrol. [04]

OR

(c') Calculate the minimum amount of oxygen and air required in kg for the complete combustion of 1 kg of a coal sample containing 95% carbon and remaining incombustible matter. Calculate the w/w o/o composition of dry flue gases. [04]

4. (a) Describe the mechanism of hydrodynamic lubrication. [03]
(b) List the different types of liquid lubricants. Explain the significance of compounded lubricating oils. [04]
(c) Give the conditions of use of greases. [03]

5. Differentiate between [2.5×4]
(a) Galvanic cell and concentration cell.
(b) Chemical corrosion and electrochemical corrosion.
(c) Galvanic series and electrochemical series.
(d) Cathodic coating and anodic coating to protect iron from corrosion.

6. (a) What is a polymer? Give the classification of polymers. [03]
(b) Explain the important steps of polymerization of vinyl chloride by free radical mechanism. [03]
(c) Give the preparation, properties and uses of PTFE or BUNA rubbers. [04]
2012 – 2013
B.TECH./B.ARCH. AUTUMN (1 SEMESTER) EXAMINATION
(ELECTRICAL / MECHANICAL / CIVIL / ELECTRONICS / COMPUTER / CHEMICAL / PETRO-CHEMICAL ENGINEERING)
APPLIED MATHEMATICS – I
(AIM – 101)
Credits: 05

Maximum Marks : 60 Duration : Three Hours

Note: Answer all the questions.

1. (a) For what value of $\lambda$ the system of equations:

\[2x_1 - 3x_2 + 6x_3 - 5x_4 = \lambda\]
\[x_2 - 4x_3 + x_4 = 1\]
\[4x_1 - 5x_2 + 8x_3 - 9x_4 = \lambda\]

is consistent? Hence solve the system for that value of $\lambda$.

(b) Find the eigen values of eigen vectors of the matrix:

\[
\begin{bmatrix}
2 & 1 & 1 \\
2 & 3 & 2 \\
3 & 3 & 4
\end{bmatrix}
\]

OR

(b') Find the characteristic equation of the matrix:

\[
A = \begin{bmatrix}
2 & 1 & 1 \\
0 & 1 & 0 \\
1 & 1 & 2
\end{bmatrix}
\]

and hence find the matrix represented by

\[A^8 - 5A^7 + 7A^6 - 3A^5 + A^4 - 5A^3 + 9A^2 - A + 2I\]

2. (a) Find the pedal equation of the parabola $y^2 = 4a(x + a)$.

(b) Find the radius of curvature at the point $(r, 0)$ on the curve $r^n - a^n \sin n\theta$.

(c) Find the all possible real asymptotes of the curve:

\[4x^2 - 3xy^2 - y^3 + 2x^2 - xy - y^2 - 1 = 0\]

OR

(c') Trace the curve:

\[y = \frac{x^2 + 1}{x^2 - 1}\]
by describing the salient features.

3. (a) If $y = (\sin^{-1} x)^2$, show that $(1 - x^2)y_{n-2} - (2x + 1)x y_{n+1} + n^2 y_n = 0$ and find $(y_n)_0$.

Contd……2
(a') If \( y = e^{\ln^{-1}x} \), find the coefficient of \( x^5 \) in the expansion of \( y \) by Maclaurin's series.

(b) 
(i) Test for convergence the series whose general term is \( \frac{\sqrt{n}}{n^2 + 1} \).

(ii) Test the convergence of the series:
\[
1 + \frac{1}{2}x + \frac{1}{5}x^2 + \frac{1}{10}x^3 + \ldots + \frac{x^n}{n^2 + 1} + \ldots
\]

4. (a) If \( S \) be the length of the arc of the catenary \( y = c \cos h (x/c) \) from the vertex \((0, c)\) to the point \((x, y)\), show that

(i) \( s^2 = y^2 - c^2 \)

(ii) \( s = c \tan \psi \).

(b) Find the volume of the solid generated by the revolution of the curve \( y(a^2 + x^2) - a^3 \) about its asymptote.

OR

(b') Find the area of the curved surface of the cup formed by the revolution about its axis of the smaller part of the parabola \( y^2 = 4ax \) cut off by the line \( x = 3a \).

5. (a) Solve any TWO of the following D.E: [6+6]

(i) \((1 + xy)y \, dx + (1 - xy)x \, dy = 0\).

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

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

(b) The radical displacement \( u \) in a rotating disc at a distance \( r \) from the axis is given by \( r^2 \frac{d^2u}{dr^2} + r \frac{du}{dr} - u + kr^3 = 0 \), where \( k \) is constant. Solve the equation and determine the constants so that \( u = 0 \) when \( r = 0 \) and \( r = a \).
1. (a) Find the rank of the matrix:

\[
\Lambda = \begin{bmatrix}
1 & 2 & 3 & 0 \\
2 & 4 & 3 & 2 \\
3 & 2 & 1 & 3 \\
6 & 8 & 7 & 5 \\
\end{bmatrix}
\]

(b) Find the values of \( \lambda \) for which the following system of equations is consistent and has non-trivial solutions. Solve the system for each value of \( \lambda \).

\[
(\lambda - 1)x + (3\lambda + 1)y + 2\lambda z = 0 \\
(\lambda - 1)x + (4\lambda - 2)y + (\lambda + 3)z = 0 \\
2x + (3\lambda + 1)y + 3(\lambda - 1)z = 0 
\]

(c) Find \( \text{Adj} \ A \) by using Cayley-Hamilton theorem where

\[
A = \begin{bmatrix}
1 & 2 & 1 \\
0 & 1 & -1 \\
3 & -1 & 1 \\
\end{bmatrix}
\]

2. (a) Use Taylor’s theorem to express the polynomial \( 2x^3 + 7x^2 + x - 6 \) is powers of \( (x - 2) \).

(b) If \( \cos^{-1}\left(\frac{y}{b}\right) = \log_e\left(\frac{x}{n}\right) \), show that \( x^2y_{n+2} + (2n + 1)x\ y_{n+1} + 2n^2\ y_n = 0 \).

(c) Show that eight points of intersection of the curve

\[
x^4 - 5x^2y^2 + 4y^4 + x^3 - y^2 + x + y + 1 = 0
\]

and its asymptotes lie on a rectangular hyperbola.

OR

(c') Trace the curve \( y = \frac{x^2 + 1}{-1 + x^2} \), describing its salient features.
3. (a) Find the intrinsic equation of the cycloid \( x = a(t + \sin t), y = a(1 - \cos t) \).

(b) The area cut \( \Omega \) from the parabola \( y^2 = 4ax \) by the chord joining the vertex to an end of the latus rectum is rotated about the chord. Find the volume of the solid so formed.

OR

(b') Show that the surface area of the solid generated by revolving one complete arc of the cycloid \( x = a(\theta - \sin \theta), y = a(1 - \cos \theta) \) about a line \( y = ca \), is \( \frac{32}{3} \pi a^2 \).

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

(i) \( \int \left( \frac{x^2 y + y^2}{x^2 + y^2} \right) \, dx + \frac{x - y}{x^2 + y^2} \, dy = 0 \)

(ii) \( \frac{d^2 y}{dx^2} + y = \csc x \)

(iii) \( \frac{d^2 y}{dx^2} - 4 \frac{dy}{dx} + 4y = 8(e^{2x} \sin 2x + x^2) \)

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

(b) Solve the following system of differential equations.

\[
\begin{align*}
\frac{dx}{dt} + \frac{dy}{dt} - 2y &= 2 \cos t - 7 \sin t \\
\frac{dx}{dt} - \frac{dy}{dt} + 2x &= 4 \cos t - 3 \sin t
\end{align*}
\]

OR

(b') A particle of mass \( m \) is projected vertically upward under gravity, the resistance of the air being \( mk \) times the velocity. Show that the greatest height attained by the particle is \( \frac{v^2}{g} \left[ \lambda - \log (1 + \lambda) \right] \), where \( v \) is the terminal velocity of the particle and \( \lambda v \) is the initial velocity.
2012-2013
B.TECH. AUTUMN (I SEMESTER) EXAMINATION
(Civil/Chemical/ Computer/ Electrical/ Electronics/ Mechanical/ Petro-Chemical Engg.)
APPLIED PHYSICS-I (AP-101)
Credit: 03

Maximum Marks: 60
Answer all questions. Symbols have their usual meaning.

1. (a) What is Hall effect? Obtain an expression for majority carrier concentration in a given sample in terms of measurable parameters. Mention few applications of Hall effect.

OR

(a) Define mobility of an electron. Obtain an expression for total current density in case of a semiconductor hence write expression for electrical conductivity due to electrons and holes both.
(b) Discuss the formation of n and p type semiconductors with the help of energy band picture.
(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: $n_i=1.5 \times 10^{10}$ cm$^{-3}$ and $k_B=1.38 \times 10^{-23}$ J/K)

2. (a) What is the inertial frame of reference? Starting with proper relationship between x and x', obtain Lorentz transformation equations.
(b) Write down Maxwell's equations. Give a qualitative treatment of the traveling electromagnetic wave and show that $E_m/B_m=c$
(c) An astronaut whose height is exactly 1.8 meter is lying parallel to the axis of a spacecraft moving at 0.90c relative to the earth. What is the height as measured by an observer in the same space craft? By an observer on the earth?

3. (a) With the help of suitable diagram discuss the production mechanism of x-rays and explain the terms: Duane-Hunt limit, continuous and characteristic x-rays.
(b) Electrons are accelerated in a T.V. tube through a potential difference of about 11 kV. What is the nature and the maximum frequency of the c.m. waves emitted when these electrons strike the screen of the tube (Assume c = $3 \times 10^8$ m/s).

OR

3'(a) Discuss in brief the Compton effect. What inference do you draw from this effect? Obtain analytically the expression: $\lambda'=\lambda-\frac{h}{m_o c} (1-\cos \phi)$.
(b) An x-ray photon having frequency $1.5 \times 10^{19}$ Hz undergoes Compton scattering with an electron and emerges with a frequency of $1.2 \times 10^{19}$ Hz. Find the kinetic energy (in joules) imparted to the electron. ($h=6.63 \times 10^{-34}$ J.s)
(c) What is uncertainty principle? Write various uncertainty relations that you know.

4. (a) Discuss the physical significance of a wave function. Set up the time dependent form of Schrödinger equation and hence obtain its steady state form.

(b) The phase velocity of the ripples on liquid surface is $\sqrt{\frac{2\pi S}{\Delta \rho}}$, where S and $\rho$ are respectively surface tension and density of the liquid. Find the group velocity of the ripples.
(c) What is tunnel effect? Give an example of this effect.

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B. TECH. AUTUMN (1 SEMESTER) EXAMINATION
(ELECTRICAL/MECHANICAL/CIVIL/ CHEMICAL/ PETRO- CHEMICAL/ELECTRONICS/COMPUTER ENGINEERING)
APPLIED PHYSICS
(AP-111)
Credits-04

Maximum Marks: 60
Duration: Three Hours

Answer all questions. Symbols have their usual meaning.

1(a) Write down Fermi Dirac distribution function and define Fermi energy \( E_F \). 8.0
Obtain an expression for equilibrium concentration of electrons in conduction band in case of a semiconductor and show that product of \( n_0 \) and \( p_0 \) is constant for a given semiconductor.

OR

(a) What are direct and indirect band gap semiconductors? Derive an expression for electrical conductivity in case of a semiconductor taking the contribution of electron and hole both. 8.0
(b) Discuss superconductivity with the help of suitable diagram. Define the terms: transition temperature \( T_c \) and critical magnetic field \( B_c \). 4.0
(c) The actual energy gap at 0 K in lead is \( 2.73 \times 10^{-3} \text{ eV} \). Find out \( T_c \) and minimum frequency of radiation to break Cooper pair in lead at 0 K. 3.0

2(a) Describe in detail the construction and working of Ruby laser with help of suitable diagrams. Mention one of the major drawbacks of Ruby laser. 6.5
(b) On what principle optical fiber works? Draw a cross section of an optical fiber and name its different components. What are the advantages of optical fiber using in communication? 5.0
(c) A typical ruby laser emits radiation of 694.3 nm because of transition between the energy levels of \( \text{Cr}^{3+} \) ions. If a ruby is 5 cm long and 1 cm in diameter contains \( 10^{19} \) ions of \( \text{Cr}^{3+} \). What is the maximum energy of a pulse radiation emitted by the laser? 3.5

3(aii) Explain pair production and show that it cannot occur in empty space. 4.0
An x-ray photon of initial frequency \( 3.0 \times 10^{19} \text{ Hz} \) collides with an electron and is scattered through 90°. Finds its new frequency.

(b) Differentiate between phase and group velocities. An electron and a proton have the same velocity. Compare the wavelengths and the phase and group velocities of their de Broglie waves. 4.0

(c) Write down time independent Schrödinger equation and solve it for the wave function of a particle trapped in a box (infinite square potential well). 5.0
(d) Find the expectation value, \( \langle \chi \rangle \) of the position of a particle trapped in a box \( L \) wide. 2.0

4(b) Compare the three statistical distribution functions. Show the variation of these distribution functions as a function of energy \( (\text{for } \alpha = -1) \). 4.0
Plot the electron-energy distribution in metals and hence discuss as to why the electrons in general, do not contribute to specific heat of metals? 2.0
(c) What do you mean by nuclear cross section? Show that the number of surviving particles $N$ decreases exponentially with increasing slab thickness $x$ for a given material.

(d) What is the general working principle of nuclear detectors? Give a detailed account of Scintillation detector.

Some useful physical constants

$h = 6.63 \times 10^{-34} \text{ J.s}$, \hspace{1cm} $k_B = 1.38 \times 10^{-23} \text{ J/K}$,

$m_e = 9.1 \times 10^{-31} \text{ kg}$, \hspace{1cm} $c = 3 \times 10^8 \text{ m/s}$

$q_e = 1.6 \times 10^{-19} \text{ C}$
B. Arch. (First Semester) Examination
AR 103, Architectural Drawing – I
Credits: 4

Maximum Marks: 40
Duration Three hours

Note: -
1. Attempt all questions.
2. Good drafted drawing will be credited.
3. Assume any missing data.
4. All dimensions are in mm.

Q. 1 Represent the followings:-
   a) An architecture student with drawing sheet in elevation. 3
   b) Palm tree in elevation and plan. 3
   c) Any two different kind of textures (in box size 80 mm X 120 mm) 4

Q. 2. Draw orthographic projection of a square prism of base 30 mm x 30 mm and height 60 mm, resting on ground on one of its base edge in such a way that its central longitudinal axis is inclined at <60° to ground & edge touching the ground is making <45° to vertical plane.

OR

Q. 2. Draw orthographic projection of a cube of side 50 mm resting on one of its corner on ground in such a way that one of its solid diagonal is perpendicular to vertical plane.

Q. 3. Draw surface development of a sphere of diameter 30 mm. 10

Q. 4. Draw isometric view of the object shown in figure 1 10
B. ARCHITECTURE, AUTUMN (I SEMESTER) EXAMINATION
PRINCIPLES AND PHILOSOPHY OF ARCHITECTURE

(AR – 112)

Credits: 03

Duration: Three Hours

Maximum Marks: 60

Note: Explain all the questions, each question carry equal marks. Support your answers with suitable sketches.

1. What do you understand by the term Architecture? Explain the role of Architecture in India. [10]

2. What are the basic elements of design, explain their role with neat sketches? [10]

3. What are the allied subjects which have direct impact on Architecture? Explain the saying “Architecture is Mother of all Arts & Sciences” in this context. [10]

4. Explain any two of the following: [5×2=10]
   (a) Symmetry
   (b) Axis
   (c) Rhythm

5. Explain the philosophy of any one of the following Architects and how it is projected in their important works? [10]
   (a) Mies Vander Rohe
   (b) Le Corbusier

6. Explain the role of hierarchy as the indispensable principle of design? [10]
1. (i) Determine the effective height of a stack: given the following data
   a) Physical stack is 180 m tall and has 0.95 m inside diameter
   b) Wind velocity is 2.75 m/s
   c) Air temperature is 20°C
   d) Barometric pressure is 1000 milli bars
   e) Stack gas velocity is 11.2 m/s
   f) Stack gas temperature is 160°C

   (ii) Discuss any one of the following in relation to the control of particulates
        a) Settling Chamber
        b) Bag house Filter
        c) Cyclone Separator

   OR

   A coal burning power plant burns 6.25 tonnes of coal per hour and discharges the combustion products through a stack and has an effective height of 80 m. The coal has sulphur content of 4.7% and wind velocity at the top of the stack is 8.0 m/s. Atmospheric stability conditions are moderately to slightly stable. Determine the maximum ground level concentration of SO₂ and the distance from the stack at which it occurs.

   (10)

2. (i) Write about the various components of municipal solid waste

   (4)

(ii) Which properties a waste should have to be classified as hazardous solid waste

   (2)

(iii) Describe in brief the biological or thermal process for the resource recovery through waste processing.

   (4)

3. (i) Draw the treatment scheme for ground water. Briefly explain the purpose of each unit.

   OR

   (5)

(ii) Explain the filtration process in water treatment

   (5)

(iii) Design a sedimentation tank for water treatment for a population of 10,000 persons using 150 L of water per day.

   (5)

4. (i) Explain the low cost wastewater treatment process.

   (5)

(ii) The 5 day BOD at 20 °C of a wastewater sample is 300 mg/L. Find 12 day BOD when the temperature was 30 °C. Take k=0.23d⁻¹. Why Bureau of Indian standards recommends 3 day BOD at 27°C.

   (5)

5. (i) How air pollutants are classified on the basis of origin, chemical composition and state of matter?

   (5)

(ii) Describe the biotic and abiotic components of an ecosystem with suitable examples.

6. (i) Explain the significance of various chemical and biological parameters used to characterize water quality.

   (5)

(ii) What is the significance of biochemical oxygen demand (BOD)? Describe the suitable method for the determination of BOD in wastewater sample.

   (5)
2012-13
B.ARCH/ B.TECH (I-SEMESTER) EXAMINATION
(ELECT./MECH./CIVIL./CHEM./ELECTRONICS/COMPUTER/
PETRO-CHEM. ENGINEERING)
BASIC ELECTRICAL ENGINEERING
(EE-101)
Maximum Marks: 60
Credits: 03
Duration: Three Hours

Answer all questions
Assume suitable value for missing data, if any.
All symbols and abbreviation have their usual meanings.

1(a) State Norton's theorem as applicable to a.c network. Discuss how the 05
Thevenin's equivalent can be obtained from the Norton's equivalent.

(b) Calculate the current, power and power factor for each branch and also 07
calculate the total current, power, and power factor for overall circuit shown
in Fig.1. Draw neat phasor diagram for the circuit.

OR

1'(a) Derive an expression that relates the line and phase voltages of a star 05
connected circuit with the help of phasor diagram.

(b) Use Thevenin's theorem to calculate current in a 1000 ohm resistor 07
connected between terminals A and B as shown in Fig.2

2(a) Explain the principle of working of a transformer. What is meant by step up 05
and step down transformers?

(b) An inductor has a core built up of stampings as shown in Fig.3 the coil being 07
on the center limb. There is a 1mm air gap in the center limb which has a
cross-sectional area of 4 cm². All the other path in the core have a cross-
sectional area of 2 cm². The mean path length of the core is shown. 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 0.8 mWb.

OR

2'(a) Define magnetic field intensity and reluctance. Explain how the hysteresis 05
loss and magnetic loss occur in a ferromagnetic materials.
(b) A 25 kVA, 2,200/200 V, 50Hz single phase transformer has primary and secondary resistances of 0.8Ω and 0.009 Ω and leakage reactances of 3.2 Ω and 0.3Ω respectively. Calculate.

(i) the equivalent impedance as referred to primary and secondary side.
(ii) the total copper loss using the individual resistances of the two windings and by using equivalent resistances as referred to each side.

3.(a) Using suitable derivation explain how rotating magnetic field is produced in a three phase induction motor.

(b) Derive an emf equation of an alternator. A 3-phase, 6 pole star connected alternator revolves at 1000 rpm. The stator has 90 slots and 8 conductors per slot. The flux per pole is 0.05 Wb (sinusoidally distributed). Calculate the voltage generated by the machine if the winding factor (Kw) is 0.96.

OR

3′(a) Describe the constructional differences between a salient pole and cylindrical rotor of an alternator.

(b) Explain why the single-phase induction motor is not self starting? Explain any one method to make the single-phase induction self starting. State two applications of such motors.

4(a) Explain the working of a PMMC instrument. Why this is not suitable for AC measurement?

(b) Describe the constructional details of a single phase induction type energy meter. Show that the number of revolutions in this energy meter is proportional to energy consumed.

5(a) Draw the layout of a power system indicating various voltage levels.

(b) (i) Name the main parts of nuclear reactor. With the help of suitable diagram explain any one of them.
(ii) Write short note on pumped storage plant.
2012-13

B.TECH/B.ARCH AUTUMN (I SEMESTER) EXAMINATION

BASICS OF ELECTRICAL & ELECTRONICS ENGINEERING (EE-111)

Credits: 04

Maximum Marks: 60

Duration: Three Hours

Note:
1. Answer all questions.
2. Symbols and abbreviations have their usual meanings.
3. Any missing data may be suitably assumed.
4. Part A (Q.1&2) and Part B (Q.3&4) questions are to be attempted in separate copies.

PART A (30 Marks)

(a) Using thevenin's theorem determine the current through 4Ω resistor of figure 1 (05)

(b) A cast steel magnet has an air gap of length 2 mm and an iron path of 30 cm. Find the number of ampere turns necessary to produce a flux density 1.2 Wb/m². The relative permeability of cast steel is 900. Neglect leakage and fringing. (05)

(c) Define magnetomotive force, reluctance, permeability. State ampere's circuital law. (05)

OR

(a) Find the sinusoidal expression for the voltage $V_c$ for the system shown in figure 2 if $e_m = 120 \sin(\omega t - 30^\circ)$, $V_a = 50 \cos \omega t$, $V_b = 30 \sin \omega t$. Also draw the phasor diagram. (05)

(b) A single phase transformer working at unity power factor has an efficiency of 90% at both half load and at the full load of 600W. Determine the efficiency at 85% full load and the maximum efficiency. (05)

(c) Differentiate between real and reactive power. Derive the general expression for real and reactive power. Also give there values for purely resistive load, purely inductive load. (05)
2. (a) "Three phase induction motor is a self starting motor". Justify the statement. How can we reverse the direction of rotation of a three phase induction motor? (05)

(b) With the help of a diagram explain the construction of induction type of energy meter. Also show that the number of revolutions is proportional to energy consumed. (05)

(c) Draw the water-steam flow diagram of a coal fired thermal power plant. Explain the functions of economizer and superheaters. (05)

PART-B (30 Marks)

3. (a) What is the significance of diode model? Draw the equivalent circuits and characteristics of a PN junction diode for piecewise linear model, the constant voltage drop model and ideal diode model. (05)

(b) (i) Why collector current \( I_C \) in a transistor is slightly less than the emitter current \( I_E \) for a transistor in active region.

(ii) Why Base current in a transistor is usually much smaller than \( I_E \) or \( I_C \) in active region? (05)

(c) A Silicon junction diode with \( \eta = 1 \) has \( v = 0.7V \) at \( i = 1mA \). Find the voltage drop at \( i = 0.1mA \) and \( i = 10mA \). (05)

4. (a) What is the significance of DC load line in a transistor? And what are the parameters to determine the Q-point. (05)

(b) What is the major difference between Enhancement and Depletion MOSFET? Explain with the help of diagram? (05)

(c) For the circuit shown in figure 3, draw the DC load line and determine the Q-point. If zero signal base current is 40\( \mu \)A and \( \beta = 50 \). (05)

OR

4. (a) What is inversion layer? How it is created in N-Channel Enhancement MOSFET? (05)

(b) Draw the circuit of unity gain amplifier, and find out its voltage gain in DB. (05)

(c) Draw the symbol of open loop operational amplifier and explain the terms virtual short and virtual ground in an operational amplifier? (05)
1.(a) Read the passage and answer the questions that follow:  

The intuitive fact is often not very good at estimating answers to probability problems. For e.g. how many persons must there be in a room in order that the odds be favourable - that is, better than even - that there are at least two persons in the room with the same birthday? Remembering that there are 365 separate birthdays possible, some persons estimate that there would have to be 50 or even 100, persons in the room to make the odds better than even. The answer, in fact, is that the odds are better than even when there are 23 persons in the room; with 40 persons, the odds are better than eight to one that at least two will have the same birthday.

Let us consider one more e.g.: Everyone is interested in polls, which involve estimating the opinions of a large group by determining the opinions of a sample. In statistics the whole group in question is called ‘universe’ or ‘population’. Now suppose you want to consult a large enough sample to reflect the whole population with at least 98% precision / accuracy in 99 out of a hundred instances; how large does this very reliable sample have to be? If the population numbers 200 persons, then the sample must include 105 persons, or more than half the whole population. But suppose the population consists of 10,000 or 1,00,000 persons. In the case of 10,000 persons, a sample would have to consist of 213 persons, the sample increases by only 108 when the population increases by 9,800. And if you add 90,000 more to the population, you have to add only 04 to the sample. Thus, this seems to you, the more strongly I make the point that it is better to depend on the theory of probability rather than on intuition.

(i) Identify the faculty discredited while seeking statistical solutions in the passage?
(ii) What do you understand by ‘odds be favourable’ in the passage?
(iii) Make the following words negative:
   (a) precision
   (b) accuracy
(iv) What terms are employed in statistics to denote ‘sample’?
(v) Which theoretical premise is found more reliable by the author?

2.(a) Describe the year 802701 AD?

Discuss the Elois.

OR

......2.
(b) Elaborate the concept of ‘Animalism’.

OR

Describe the challenges and setbacks the animals faced in building ‘the Windmill’.

3. Write the process of opening a Savings Bank Account.

OR

Write a report on your experience of the 1st Semester that you are completing at Zakir Hussain College of Engineering and Technology, A.M.U.

4. Read the following passage:

Quasi-stars are a new phenomenon in the universe, and everybody is wondering what they are. Their light seems too bright to come from any known physical process. They broadcast powerful radio waves which may vary in strength. Some of them lie near the limits of observable space and time, and promise to provide a crucial test of rival theories of the universe.

Quasi-stars were discovered in 1963 as a result of an effort to overcome the shortcomings of radio telescopes. Compared to optical telescopes, these are blunt instruments. They can spot a radio star but can give only the most general clues as to its distance or nature. Progress depends on identifying radio stars with some kind of object emitting visible light – but radio astronomers can give their optical colleagues only rather imprecise directions as to where to look.

It occurred to Cyril Hazard radio astronomer working at Jodrell Bank in England, that the moon could help. By waiting for it to eclipse radio star, and timing the eclipse very precisely, a much more accurate position could be calculated. When astronomers look at the sky, they expect to see either a star or a galaxy

Make notes and write a summary of the passage given above.

5.(a) Using appropriate words from the given list, fill in the blanks in the following:

The scientist or technologist uses many _____ when he tries to _____ a problem. For instance, an engineer who wants to _____ liquid from one _____ to another has the choice of several different _____.

[ raise, procedures, level, methods, solve]

(b) Write an essay on any one of the following topics in about 400 words:

(i) Scientific progress and ethics
(ii) My favourite book
Assume any suitable data if missing.
Use of Steam Tables is allowed.


Q2.a. In a steady flow open system a fluid substance flows at the rate of 4 kg/s. It enters the system at a pressure of 600 kN/m², a velocity of 220 m/s, internal energy 2200 kJ/kg and specific volume 0.42 m³/kg. It leaves the system at a pressure of 150 kN/m², a velocity of 145 m/s, internal energy 1650 kJ/kg and specific volume 1.5 m³/kg. During its passage through the system, the substance has a loss by heat transfer of 46 kW/kg to the surroundings. Determine the power of the system, stating it is from or to the system. Neglect any change of gravitational potential energy.

b. A system consisting of 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 the temperature rises to 1500 °C.
   (iii) The temperature of the products 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
Q2-a. Prove that energy is a property.

(b) An indicator spring is found to require an axial force of 60 N to shorten it by 1.0 mm. The spring is used in an indicator having a piston area of 4 cm² and a pencil mechanism which magnifies the motion of the indicator piston six-fold.

(i) Calculate the spring number in N/m³.

(ii) A single-cylinder, single-acting, 4-stroke gas engine of 150 mm bore develops an indicator power of 4.5 kW when running at 216 rev/min. Calculate the area of the indicator diagram that would be obtained using the above indicator, given that the length of the diagram is 0.1 times the length of the stroke of the engine.

Q3.

(i) A rigid vessel of volume 0.58 m³ contains 1 kg of steam at a pressure of 300 × 10³ N/m². Evaluate the specific volume, the temperature, the dryness fraction, the internal energy and the enthalpy of the steam.

(ii) Heat transfer to the steam causes its temperature to rise to 160 °C. Show the path of this process on a sketch of the p-v diagram and evaluate the pressure, the increase in enthalpy, the increase in internal energy of the steam and the heat transfer. Evaluate also the pressure at which the steam becomes dry-saturated.

OR

Q3'-a. A pure substance is contained in a cylinder closed by a piston. A paddle wheel, rotated by means of a shaft protruding through the cylinder wall, causes the substance to undergo a fully-resisted constant pressure process as the piston moves outwards. There is no heat transfer during the process. Show that the stirring work done on the substance is equal to the increase in the enthalpy of the substance.

(b) A sample of wet steam from a steam main flows steadily through a partially open valve into a pipe-line in which is fitted an electric coil, the valve and the pipe-line are well insulated. The steam mass flow rate is 0.007 kg/s while the coil takes 3.78 amperes at 230 Volts. The main pressure is 400 × 10³ N/m² and the pressure and temperature of the steam downstream of the coil are 200 × 10³ N/m² and 155 °C respectively. Steam velocities may be assumed to be negligible.

(i) Evaluate the dryness of the steam in the main.

(ii) State, with reasons, whether an insulated throttling calorimeter could have been used for this test.

Q4-a. Define:

(i) Heat Engine
(ii) Reversible engine
(iii) Reversible process

b. Establish the equivalence of Kelvin-Planck & Clausius statements of Second Law of Thermodynamics.

OR
A vapour-compression refrigerator uses methyl-chloride as the working fluid. The fluid flows steadily into the compressor at a pressure of $119 \times 10^3$ N/m$^2$ and is delivered to the condenser as dry saturated vapour at a pressure of $653 \times 10^3$ N/m$^2$. The fluid leaves the condenser as saturated liquid at a pressure of $653 \times 10^3$ N/m$^2$ and after expansion in the throttle valve to pressure of $119 \times 10^3$ N/m$^2$, it flows through the evaporator and thence back into the compressor again. The compression process may be assumed to be reversible and adiabatic and the throttling process to be adiabatic. Changes in kinetic energy and in elevation are negligible.

(i) Evaluate the dryness fraction of the fluid entering the compressor and hence the shaft work done per unit mass of refrigerant.

(ii) Evaluate the dryness fraction of the fluid after the throttling process.

(iii) Evaluate the heat transfer per unit mass to the refrigerant in the evaporator.

(iv) Evaluate the coefficient of performance of the refrigerator and compare it with the value for a reversed Carnot cycle operating between the given temperature limits.

Use the data for methyl-chloride given below:

<table>
<thead>
<tr>
<th>Pressure $\text{N/m}^2$</th>
<th>Saturation temperature $^\circ\text{C}$</th>
<th>Specific enthalpy $\text{kJ/kg}$</th>
<th>Specific entropy $\text{kJ/kg-K}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$119 \times 10^3$</td>
<td>-20</td>
<td>Saturated liquid</td>
<td>30.1</td>
</tr>
<tr>
<td>$653 \times 10^3$</td>
<td>30</td>
<td>Saturated vapour</td>
<td>455.2</td>
</tr>
</tbody>
</table>

Q5-a. Briefly explain the mechanisms of conduction, convection and radiation modes of heat transfer.

b. A 100 mm diameter steam main is covered by two layers of lagging. The inside layer is 40 mm thick and has a coefficient of thermal conductivity of 0.07 W/m-K. The outside layer is 25 mm thick and has a coefficient of thermal conductivity of 0.1 W/m-K. The main conveys steam at a temperature of 235 $^\circ\text{C}$. The outside temperature of the lagging is 24 $^\circ\text{C}$. If the steam main is 20 m long, determine:

(i) The heat lost per hour

(ii) The interface temperature of the lagging

Neglect the temperature drop across the steam main.
2012-2013
B.TECH. AUTUMN (1 SEMESTER) EXAMINATION
(ELECTRICAL / ELECTRONICS / MECHANICAL / COMPUTER / CHEMICAL /
PETROCHEMICAL ENGINEERING & B. ARCH.)

ENGINEERING MECHANICS
(ME-103)
CREDIT : 04

Maximum Marks : 60
Duration : Three Hours

Note:
(i) Answer ALL questions.
(ii) Assume data, if missing.

1(a). A transmission tower is held by three guy wires anchored by bolts at B, C, and D. If the tension in wire AB is 2100 N, determine the components of the force exerted by the wire on the bolt at B. (Refer Fig.1) [6]

1(b). The shafts of an angle drive are acted upon by the two couples shown. Replace the two couples with a single equivalent couple, specifying its magnitude and the direction of its axis. (Refer Fig.2) [6]

OR

1*(a). The lever BCD is hinged at C 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. (Refer Fig.3) [6]

1*(b). Wire is being drawn at a constant rate from a spool by applying a vertical force P to the wire as shown. The spool and the wire wrapped on the spool have a combined weight of 20 N. Knowing that the coefficients of friction at both A and B are \( \mu_s = 0.40 \) and \( \mu_k = 0.30 \), determine the required magnitude of the force P. (Refer Fig.4) [6]

2(a). Determine by integration the centroid of the area shown. Express your answer in terms of \( a \) and \( h \). (Refer Fig.5) [5]

2(b). Determine the moment of inertia and the radius of gyration of the shaded area shown with respect to the x axis. (Refer Fig.6) [7]

OR

2(b*). Derive an expression for the magnitude of the couple M required to maintain the equilibrium of the linkage shown. (Refer Fig.7) [7]

Contd.....2
3. Air planes A and B are flying at the same altitude and are tracking the eye of hurricane C. The relative velocity of C with respect to A is $V_{C/A} = 470 \text{km/h}$, $75^\circ$ and the relative velocity of C with respect to B is $V_{C/B} = 520 \text{km/h}$, $40^\circ$. Determine: (a) the relative velocity of B with respect to A, (b) the velocity of A if ground based radar indicates that the hurricane is moving at a speed of $48 \text{km/h}$ due north, (c) the change in position of C with respect to B during 15 minute interval (Refer Fig. 8) [12]

4(a). The acceleration of a package sliding down section AB of incline ABC is $5.49 \text{m/s}^2$. Assuming that the coefficient of kinetic friction is the same for each section, determine the acceleration of the package on section BC of the incline. (Refer Fig. 9) [6]

4(b). A 5 kg collar B can slide without friction along a horizontal rod and is in equilibrium at A when it is pushed 125 mm to the right and released. The undeformed length of each spring is 300 mm and the constant of each spring is $k = 280 \text{N/m}$. Determine (a) the maximum velocity of the collar (b) the maximum acceleration of the collar. (Refer Fig. 10) [6]

OR

4(b'). A system consists of three particles A, B, and C. We know that $m_A = 3 \text{ kg}$, $m_B = 4 \text{ kg}$, and $m_C = 5 \text{ kg}$ and that the velocities of the particles expressed in m/s are respectively $V_A = -4 \text{ i} + 4 \text{ j} + 6 \text{ k}$, $V_B = V_x \text{ i} + V_y \text{ j} + 4 \text{ k}$, and $V_C = 2 \text{ i} - 6 \text{ j} - 4 \text{ k}$. Determine (a) the components $V_x$ and $V_y$ of the velocity of particle B for which the angular momentum $H_0$ of the system about O is parallel to the Z-axis, (b) the corresponding value of $H_0$. (Refer Fig. 11). [6]
5(a). The circular plate shown is initially at rest. Knowing that $r=200\text{mm}$ and that the plate has a constant angular acceleration of $0.3\ \text{rad/s}^2$, determine the magnitude of the total acceleration of point B when $t=0$ (Refer Fig.12).

5(b). The thin plate ABCD of mass 8kg is held in the position shown by the wire BH and two links AE and DF. Neglecting the mass of the links, determine immediately after wire BH has been cut (a) the acceleration of the plate, (b) the force in each link. (Refer Fig.13).

(Fig. Attached)
2012-2013  
B.TECH. AUTMN (I SEMESTER) EXAMINATION  
(ELECTRICAL/ELECTRONICS/MECHANICAL/COMPUTER/CHEMICAL/ 
PETRO-CHEMICAL/B.ARCH/CIVIL ENGINEERING)  
APPLIED MECHANICS (ME-111)  

Maximum Marks: 60  Duration: Three Hours  

Answer ALL questions.  
Assume suitably if any data missing.  
Question should be answered in ascending order.  

(a) Two transmission belts pass over sheaves welded to an axle supported by bearings at B and D. The sheave at A has a radius of 50mm, and the sheave at C has a radius of 40mm. Knowing that the system rotates at a constant rate; determine: (a) the tension T, (b) the reactions at B and D. Assume that the bearing at D does not exert any axial thrust and neglect the weights of the sheaves and axle. (Refer Fig. 1)  

OR  

(a) The elevation of the end of the steel beam supported by a concrete floor is adjusted by means of the steel wedges E and F. The base plate CD has been welded to the lower flange of the beam, and the end reaction of the beam is known to be 100KN. The coefficient of static friction is 0.30 between two steel surfaces and 0.60 between steel and concrete. If the horizontal motion of the beam is prevented by the force Q, determine (a) the force P required to raise the beam (b) the corresponding force Q. (Refer Fig. 2)  

(b) Knowing that the line of action of the force Q passes through point C, derive an expression for the magnitude of Q required to maintain equilibrium. (Refer Fig. 3).  

(b) A system consists of three particles A, B, and C. We know that \(m_A = 3kg\), \(m_B = 4kg\) and \(m_C = 5kg\) and that the velocities of the particles expressed in \(m/s\) are respectively, \(V_A = 4i + 4j + 6k\), \(V_B = -6i + 8j + 4k\) and \(V_C = 2i - 6j - 4k\). Determine the angular momentum \(H_0\) of the system about O. (Refer Fig. 4)  

(b) Three spheres, each of mass \(m\), can slide freely on a frictionless, horizontal surface. Spheres A and B are attached to an inextensible, inelastic cord of length 1 and are at rest in the position shown when sphere B is struck squarely by sphere C which is moving to the right with a velocity \(V_0\). Knowing that the cord is slack when sphere B is struck by sphere C and assuming perfectly elastic impact between B and C,
determine (a) the velocity of each sphere immediately after the cord becomes taut, (b) the fraction of the initial kinetic energy of the system which is dissipated when the cord becomes taut. (Refer Fig. 5) [06]

OR

2'. Three small identical spheres A, B, and C, which can slide on a horizontal, frictionless surface, are attached to three 200mm long strings, which are tied to a ring G. Initially the spheres rotate clockwise about the ring with a relative velocity of 0.8m/s and the ring moves along the x-axis with a velocity \( V_0 = 0.4m/s \) i. Suddenly the ring breaks and the three spheres move freely in the xy plane with A and B following paths parallel to the y axis at a distance \( a = 346mm \) from each other and C following a path parallel to the x axis. Determine (a) the velocity of each sphere, and (b) the distance d. (Refer Fig. 6) [12]

3(a) The bent rod ABCDE rotates about a line joining points A and E with a constant angular velocity of 9 rad/s. Knowing that the rotation is clockwise as viewed from E, determine the velocity and acceleration of corner C. (Refer Fig. 7) [06]

3(b) Arm ACB rotates about point C with an angular velocity of 40 rad/s counterclockwise. Two friction disks A and B are pinned at their centers to arm ACB as shown in Figure-8. Knowing that the disks roll without slipping at surfaces of contact, determine the angular velocity of (a) disk A, (b) disk B. [06]

OR

3(b') In the position shown in Figure-9, bar AB has an angular velocity of 4 rad/s clockwise. Determine the angular velocity of bars BD and DE. [06]

4. Determine \( \sigma \), e, and \( \Delta \) for each free body diagram and the total structure shown in Figure-10. Take \( E = 2 \times 10^8 N/mm^2 \). [12]

OR

4'. Determine \( \Sigma e_v \) in a cuboid shown in Figure-11. Dimensions along \( P_1, P_2 \), and \( P_3 \) are 2m, 1m and 0.5m respectively. \( E = 2 \times 10^8 N/mm^2 \). [12]

5(a) Analyse the overhanging beam and draw SFD and BMD. Find the point of contraflexure also. (Refer Fig. 12) [09]

5(b) Write the equation of bending and equation of torsion and explain the notations used. [03]
Fig. 1

Fig. 2

Fig. 3

Fig. 4

Fig. 5

Fig. 6