B.TECH. (WINTER II SEMESTER) EXAMINATION
(ELECTRICAL/MECHANICAL/CIVIL/CHEMICAL/ELECTRONICS/COMPUTER/PETRO-
CHEMICAL ENGINEERING)
(APPLIED CHEMISTRY II)
(AC-102)

Maximum Marks: 60
Credits: 03
Duration: Three Hours

Answer all the questions.
Marks are allotted against each question.
Notations used have their usual meaning.

Q.No. Question M.M.
1(a) How scale and sludge are formed in the boiler? What are the methods used for their prevention? [08]
1(b) A water sample contains the following impurities in mg/L
\[ \text{Ca(HCO}_3\text{)}_2 = 16.2; \text{Mg(HCO}_3\text{)}_2 = 14.6; \text{CaSO}_4 = 13.6; \text{MgSO}_4 = 2.4 \]
[Atomic mass: Ca = 40; Mg = 24; S = 32; O = 16; C = 12; H = 1]
a) Calculate temporary and permanent hardness in mg/L
b) Calculate the amount of lime and soda required to soften one litre of water.

OR

1'(a) Explain Zeolite process of water softening. What are its advantages over lime soda process? [08]
1'(b) Describe various steps involved in the treatment of water for drinking purpose. [10]
2(a) How coals are classified? Explain the significance of moisture and volatile matter in proximate analysis of coal. [08]
2 (b) The composition of a coal sample was found to be as follows
\[ C = 90\%; H = 4.5\%; S = 0.5\%; N = 0.5\%; O = 2\% \text{ and ash} = 2.5\% \]
Calculate Gross and Net calorific values by Dulong’s formula. Latent heat of steam = 587 cal/g

OR

2'(a) Describe Fischer-Tropsch method for the manufacture of synthetic petrol. [10]
2'(b) A petrol sample contains C = 80% and H = 16% by weight. Calculate minimum air required for complete combustion of one Kg of petrol [08]
3 (a) Differentiate between chemical and electrochemical corrosion with examples. [04]
3 (b) Describe the mechanism of electrochemical corrosion involving evolution of hydrogen. [08]
4 (a) Differentiate between hydrodynamic and boundary lubrication mechanism. [04]
4(b) What is the composition of grease? Describe the function of each component. What are the conditions where grease is used as lubricant?
Maximum Marks: 60

Credits: 04

Duration: Three Hours

Answer all the questions.
All questions carry equal marks

Q.No. | Question | M.M. |
--- | --- | --- |
1(a) | Explain the principle of gravimetric analysis. Highlight the favourable conditions for the precipitation. | [04] |
(b) | Explain why precipitation titration is less popular than acid-base and redox titrations. | [02] |
(c) | Giving suitable example discuss the principle and procedure for a complexometric titration. | [04] |

OR

1'(a) | Draw the block diagram of a single beam uv-visible spectrophotometer. Explain the role of monochromator and detector. | [04] |
(b) | Explain the principle of chromatography. Distinguish between ‘paper chromatography’ and ‘thin layer chromatography’. | [04] |
(c) | Discuss Beer-Lambert’s law. | [02] |

2(a) | Write notes on the following: | [06] |

(i) Priming and foaming
(ii) Boiler corrosion
(iii) Requirements of a good disinfecting agent

(b) A sample of water contains the following impurities in mg/L: | [04] |

\[ \text{Ca(HCO}_3\text{)}_2 = 48.6, \text{Mg(HCO}_3\text{)}_2 = 5.8, \text{MgCl}_2 = 13.3, \text{CaSO}_4 = 6.8, \text{Na}_2\text{SO}_4 = 18.0, \]

Contd....2
NaCl = 15.5 and FeSO₄₇H₂O = 2.8.
(i) Calculate temporary and permanent hardness in mg/L and degree Clark
(ii) Calculate the amount of lime and soda required to soften 100 litres of water
[Given: Atomic weights of Ca = 40, Mg = 24, Cl = 35.5, S = 32, O = 16, C = 12, H = 1, Na = 23, Fe = 56]

OR

2(a) Write the reactions for the following: [03]
(i) Removal of temporary hardness by boiling.
(ii) Lime with temporary hardness.
(iii) Soap with Ca - hardness.

(b) Differentiate between distilled water and demineralized water. Describe the ion exchange process for the removal of ionic impurities from water. How ion exchangers are regenerated? [07]

3(a) Mention the advantages and disadvantages of gaseous fuels. [03]
(b) What is cracking? Highlight the advantages of catalytic cracking. [03]
(c) A coal has the following composition by weight: C = 90 %, O = 3.0 %, S = 0.5 %, N = 0.5 and ash = 2.5 %. Net calorific value of the coal was found to be 8,490.5 kcal/kg. Calculate the percentage of hydrogen and higher calorific value of coal. [04]

4(a) Describe the mechanism of thin film lubrication. [03]
(b) Discuss the solid lubricants by describing conditions for their use. [03]
(c) What do you understand by consistency and drop point of grease? Explain their significance. [04]

5(a) Discuss the importance of electrochemical series. [03]
(b) Describe the mechanism of corrosion of iron in alkaline or neutral media. [04]
(c) Discuss the corrosion control by cathodic protection using sacrificial anodic method. [03]

6(a) Discuss the mechanism of free radical addition polymerization of vinyl chloride. [04]
(b) Distinguish between thermoplastic and thermosetting resins. [03]
(c) Write short note on PVC or BUNA rubber. [03]
Note: Answer all the questions. Use of programmable calculators is not allowed.

Q.No.  Question  M.M.

1(a) Write salient features and trace the conic

\[ 3x^2 + 8xy - 3y^2 - 40x - 20y + 50 = 0. \]

(b) Find the equation of the right circular cylinder of radius 5 and axis

\[ \frac{x-2}{2} = \frac{y-3}{-1} = \frac{z+1}{3}. \]

OR

(b') A circle passing through the focus of a conic whose latus rectum is \(2\ell\) meets the conic in four points whose distance from the foci are \(r_1, r_2, r_3\) and \(r_4\). Show that

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

2(a) If \( u = \log (x^3 + y^3 + z^3 - 3xyz) \), show that

\[ \left( \frac{\partial}{\partial x} + \frac{\partial}{\partial y} + \frac{\partial}{\partial z} \right)^2 u = -\frac{9}{(x+y+z)^2}. \]

(b) If \( V = f(r) \) where \( r^2 = x^2 + y^2 + z^2 \), show that

\[ \frac{\partial^2 V}{\partial x^2} + \frac{\partial^2 V}{\partial y^2} + \frac{\partial^2 V}{\partial z^2} = \frac{d^2 V}{dr^2} + \frac{2}{r} \frac{dv}{dr}. \]

OR

(b') If \( x = r\cos \theta, y = r\sin \theta \), prove that

\[ x^2 \frac{\partial^2 V}{\partial x^2} - 2xy \frac{\partial^2 V}{\partial x \partial y} + y^2 \frac{\partial^2 V}{\partial y^2} = \frac{\partial^2 V}{\partial \theta^2} + r \frac{\partial V}{\partial r}. \]

Contd........
3(a) Expand \( \frac{(x+h)(y+k)}{x+y+h+k} \) in powers of \( h,k \) upto second degree terms.

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

4 Answer any two of the following:

(a) Prove that the volume enclosed by the cylinders

\[ x^2 + y^2 = 2ax \quad \text{and} \quad z^2 = 2ax \quad \text{is} \quad \frac{128a^3}{15}. \]

(b) Prove that the area in the positive quadrant, bounded by the curves

\[ y^2 = 4ax, \quad y^2 = 4by, \quad xy = c^2 \text{ and } xy = d^2 \quad \text{is} \quad \frac{1}{3}(d^2 - c^2)\log \left( \frac{b}{a} \right). \]

(c) Evaluate the triple integral

\[ \int_0^a \int_0^{\sqrt{a^2-z^2}} \int_0^{\sqrt{a^2-y^2-z^2}} (x^2 + y^2 + z^2) \, dx \, dy \, dz. \]

5(a) Given that \( f(x) = x + x^2 \) for \(-\pi \leq x \leq \pi\), find the fourier series expansion of \( f(x) \) and deduce that

\[ \frac{\pi^2}{6} = 1 + \frac{1}{2^2} + \frac{1}{3^2} + \frac{1}{4^2} + \ldots \]

(b) Obtain the Fourier series expansion for

\[ f(x) = x^3 \quad \text{for} \quad -\pi < x < \pi. \]
1. (a) Show that for the surface \(xyz\)
\[
x \ y \ z = c, \quad \frac{\partial^2 z}{\partial x \partial y} = -(x \log e)^{-1} \text{ at the point } x = y = z.
\]

OR

(a') If \(u = \sin^{-1}\left(\frac{x}{y}\right) + \tan^{-1}\left(\frac{y}{x}\right)\), prove that, \(x \frac{\partial u}{\partial x} + y \frac{\partial u}{\partial y} = 0\).

(b) If \(x = \sin \theta \sqrt{1 - e^2 \sin^2 \phi}, y = \cos \theta \cos \phi\), then
prove that
\[
\frac{\partial (x, y)}{\partial (\theta, \phi)} = -\sin \phi \frac{(1 - c^2) \cos^2 \theta + c^2 \cos^2 \phi}{\sqrt{1 - c^2 \sin^2 \phi}}
\]

(c) If \(z = f(x, y)\) and \(x = e^u + e^{-v}\) and \(y = e^{-u} - e^v\), prove that
\[
\frac{\partial z}{\partial u} - \frac{\partial z}{\partial v} = x \frac{\partial z}{\partial x} - y \frac{\partial z}{\partial y}. \quad [5+5+5]
\]

2. (a) Expand \(f(x, y) = \sin x \ y\) in powers of \((x - 1)\) and \(\left(y - \frac{\pi}{2}\right)\) up to the second degree terms.

(b) The time of oscillation of a simple pendulum in given by the equation
\[
T = 2\pi \sqrt{\frac{\ell}{g}}.
\]
In an experiment carried out to find the value of \(g\), errors of 1.5% and 0.5% are possible in the values of \(\ell\) and \(T\) respectively. Show that the error in the calculated value of \(g\) is 0.5%.

OR

(b') The indicated horse power \(I\) of an engine is calculated from the formula,
\[
I = \frac{PLAN}{33000}, \quad \text{where} \quad A = \frac{\pi d^2}{4}.
\]
Assuming that the errors of \(r\) percent may have been made in measuring \(P, L, N\) and \(d\), find the greatest possible error in \(I\).
3. (a) Find the volume under the plane \( z = x + y \) and above the area cut from the first quadrant by the ellipse \( 4x^2 + 9y^2 = 36 \).

OR

(a') Evaluate \( \int_0^\infty \int_0^\infty e^{-(x^2+y^2)} \, dy \, dx \) by changing to polar coordinates.

(b) Evaluate by using the transformation \( x + y = u, \ y = uv \) the following integral,

\[
\int_0^1 \int_0^{1-x} \frac{1}{e^{x+y}} \, dy \, dx.
\]

(c) Find by Triple integration the volume cut from the sphere \( x^2 + y^2 + z^2 = a^2 \) by the cone \( x^2 + y^2 = z^2 \).

4. (a) Trace the conic,

\[ x^2 + 24xy - 6y^2 + 28x + 36y + 16 = 0. \]

Give its salient features.

(b) If \( PSP' \) and \( QSQ' \) are two perpendicular focal chords of a conic, prove that,

\[ \frac{1}{PS \cdot SP'} + \frac{1}{QS \cdot SQ'} \]

is constant.

OR

(b') If \( S \) is a focus and \( 2 \ell \), the latus rectum of a conic. If a circle passing through \( S \) intersects the conic at \( A, B, C, D \), show that,

\[ \frac{1}{SA} + \frac{1}{SB} + \frac{1}{SC} + \frac{1}{SD} = \frac{2}{\ell}. \]
B.TECH. (WINTER SEMESTER) EXAMINATION
(Civil/ Chemical/ Computer/ Electrical/Electronics/ Mechanical/ Petrochemical Engg.)
APPLIED PHYSICS-II
(AP-102)

Maximum Marks: 60  
Credits: 03  
Duration: Three Hours

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

1(a) With the help of suitable diagrams explain the terms; optical pumping, induced absorption, spontaneous emission, stimulated emission and temporal coherence.  

OR

(a') What are different characteristics of laser light? Based on these characteristics discuss any two applications.

(b) Discuss construction and working of ruby laser with the help of energy level diagram. What is main drawback of ruby laser?

(c) A typical ruby laser emits radiation of 694.3 nm because of transition between the energy levels of Cr$^{3+}$ ions. If a ruby 5 cm long and 1 cm in diameter contains $10^{10}$ of Cr$^{3+}$ ions/cm$^3$. What is the maximum energy of a laser pulse? (given: $h = 6.63 \times 10^{-34}$ J.s and $c = 3 \times 10^8$ m/s)

2(a) Categorize optical fibers on the basis of refractive index and draw corresponding diagrams. What are the advantages of optical fiber communication system over conventional system?

(b) What do you understand by superconductivity? Discuss Meissner effect in a superconductor with the help of suitable diagram.

(c) What are high Tc superconductors (HTSC)? Give any two examples of HTSCs.

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

(b) Write speed distribution of ideal gas molecules and show that most probable speed of ideal gas molecules is given by $(2kT/m)^{1/2}$

OR

3'(a) Distinguish between three types of statistical distribution functions and show the variation of these distribution functions with energy.

(b) Discuss the physical significance of Fermi energy. Use the expression for number of quantum states, g(ε)dε of free electrons in metals to obtain an expression for Fermi energy

(c) 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?

4(a) What are exoergic and endoergic nuclear reactions? Show that threshold energy, $E_{th}$ of an endoergic nuclear reaction is given by: $E_{th} = - Q (1 + m/M)$

(b) Discuss the physical significance of nuclear cross section. A slab of absorber is exactly one mean free path thick for a beam of certain incident particles. What percentage of the particles will emerge from the slab?

(c) Give an account of working principle and construction of a scintillation detector. In what way is it superior to gas filled detectors?

OR

(c') Briefly discuss various features of a breeder reactor. With reference to breeder reactor, explain with example the terms: fertile material, breeding reaction and doubling time.

(3054)
1(a) Write the expression for intrinsic carrier concentration at finite temperature in terms of effective masses, and extrinsic carrier concentration in terms of intrinsic carrier concentration, defining all the parameters. Explain the temperature dependence of carrier concentration with the help of characteristic graphs for the same. [5.5]

(b) What is compensation and space charge neutrality? Explain with the help of suitable diagram. [3.5]

(b’) A sample of silicon is doped with $10^{17}$ phosphorus atoms/cm$^3$. What would you expect to measure for its resistivity if the mobility is 700 cm$^2$/V-s? What Hall voltage would you expect in a sample 100μm thick if $I_x = 1 mA$ and $B_z = 10^{-5}$ Wb/cm$^2$? [3.5]

(c) Explain DC and AC Josephson effects and define one volt. Discuss the working and applications of SQUID. [6.0]

2(a) Describe in detail the construction and working of He-Ne laser. Compare He-Ne laser with Ruby Laser. [6.0]

(a’) With the help of suitable diagrams explain the terms: Induced absorption, Spontaneous emission, stimulated emission and population inversion. Also, discuss spatial and temporal coherence. [6.0]

(b) With reference to optical fibers briefly explain the following terms giving suitable diagrams wherever applicable: total internal reflection, acceptance angle, refraction angle, critical angle, numerical aperture, step index and graded index optical fibers. Mention the advantages of optical fibers in communication. [6.0]

(c) A Si fiber has a numerical aperture of 0.17 and a cladding refractive index of 1.46. Determine the acceptance angle of the fiber and the critical angle at core-cladding interface. [3.0]

3(a) Explain the terms- phase velocity and group velocity. Show that the group velocity, $v_g$ associated with a moving particle is always equal to the velocity of the particle, $v$. [6.0]

(a’) Mention essential conditions for pair production to take place. Find the energy of an incident photon if it can impart a maximum kinetic energy of 30 keV to an electron in a Compton scattering experiment. [6.0]
(b) What do you mean by a well behaved wave function? Set-up the time dependent form of Schrödinger equation for matter waves and hence obtain its steady state (time independent) form.

4(a) Use molecular energy distribution, \( n(\varepsilon)\, d\varepsilon \) of an ideal gas molecules to find an expression for molecular speed distribution, \( n(v)\,dv \) and hence show that average speed of ideal gas molecules is \( (8kT/\pi m)^{1/2} \).

OR

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

(b) Give an account of a fusion reactor with special reference to breakeven, ignition and confinement quality parameter. Discuss one of the methods for confinement of the plasma in the proposed fusion reactor.

OR

(b') Name various nuclear detectors and write basic principle involved in the working of these detectors. Discuss the construction and working of a gas filled detector and draw the pulse height (or count per minute) vs applied voltage graph and mark various regions of operation on it.

(c) Define energy balance or Q-value of a nuclear reaction. The Q-value of the nuclear reaction: \( ^{23}\text{Na} + ^{1}_n = ^{4}\text{He} + ^{20}\text{F} \), is - 5.4 MeV. Find the threshold energy of this endoergic nuclear reaction.
1. Draft plan, elevation and section of Ledged, braced and battened door on a suitable scale. The width of door is 900 mm and height is 1950 mm. (09)

2. Draft any 4 details on a suitable scale.
   a) Closed Mortice and Tenon joint
   b) 4 types of joints for battens
   c) Section of timber log
   d) Elevation and section of chamfered ashlar masonry
   e) Plans of alternate courses of 1 ½ brick wall with English bond. (16)

3. Discuss the defects in timber.

   OR

3'. Discuss different types of stones used in construction industry.

4. What is Flemish bond? Discuss its advantages and disadvantages. (10)
   Draw plans of alternate courses for 1 ½ thick brick wall in Double Flemish bond at square stopped end.
B. ARCHITECTURE (WINTER II-SEMESTER) EXAMINATION
ARCHITECTURAL DRAWING -I
AR-103

Maximum Marks: 40 Credits: 04 Duration: Three Hours

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

1(a) Draw horizontal and vertical lines of uniform thickness and intensity at a distance of 5 mm within a square of side 100 mm

1(b) Write down the following sentence in a single stroke vertical free hand printing of 12 mm height.

"POOR LETTERING MARS THE APPEARANCE OF DRAWING"

2. Represent the following:
   - Plan and Elevation of Palm tree.
   - A person walking on street
   - Air craft in elevation
   - Plan of a car

3. A thin pentagonal plate of negligible thickness of side 50 mm has a circular hole of 40 mm diameter in its centre. The plate is resting on one of its sides on H.P. with its plane perpendicular to V.P. and 45° inclined to H.P. Draw its orthographic projections.

   OR

3' A cylinder of base diameter 40 mm & height 60 mm is lying on ground in such a way that its longitudinal axis is parallel to H.P. & inclined at < 60° to V.P. Draw its orthographic projections.

4. Draw orthographic projections of a cube of 40 mm long edges resting on the H.P. on one of its corner with solid diagonal perpendicular to the V.P.
OTE: i) Write to the point answering all questions availing inbuilt or other-wise choice.
   ii) Support your write-ups with relevant examples and quotes.
   iii) Neat presentation of Graphics and write-ups carry additional weight-age within maximum
       marks of each questions.

1. Design and presents a composition on a half imperial sheet with half inch margin all round having
   squares, circles and equilateral triangles of different sizes, colours and drawn textures. The
   composition designed shall be taken as a graphic to adorn the exterior wall of department of
   architecture building as a mural seen on a portrait format and have to have mono chromatic colour
   scheme in medium of your choice. The elements may overlap, juxtapose or detach from each other,
   none loosing their basic identity. Allow sufficient time out of the maximum time of three hours
   allowed, for drying if water based colours used for presentations.

   [15]

2. Differentiate between any three of the following supported by sketches:

   Additive forms and Subtractive forms.
   Composition and Assemblage.
   Mural and collage.
   Colour Tint and Colour Tone.

   [15]

3. What are the functional and emotional values of Art. How an Architect can employ art and artefacts to
   make designs functionally efficient, emotionally satisfying and aesthetically beautiful.
   OR

3'. What do you understand by term “Good Design”? Discuss various attributes of a good design.
Q.No.  

1. Draw perspective view of the object shown in figure-1. (Eye level = 60 mm) [20]  

2. Draw siagraphy in plan and elevation of the object shown in figure -1 (Sun ray are inclined at <45° to ground level in elevation and at <45° to vertical plane in plan.) [20]  

OR  

2'. Draw siagraphy in plan and elevation of the object shown in figure -2 (Sun ray are inclined at <45° to ground level in elevation and at <45° to vertical plane in plan.) [20]
1. Derive anthropometrically the optimum size required for the following spaces showing necessary activities, furniture required, movement areas, etc.
   a) Lavatory for a restaurant catering 20-25 persons at a time.
   b) Drawing cum dining room
      Drawing required to a scale of (1:20)
      (2x5)
      
      i) Plan
      ii) One sectional elevation

   OR

   1'. Design a kiosk for International Book Traders which serves as a book and stationary stall located in the atrium of a mall in your city.
      Drawing required to a scale of (1:20)
      (2x5)
      
      i) Plan/ Plans
      ii) Elevation/ View

2. The Primary Health Centres are established and maintained by State Government under the Minimum Needs Programme to meet the health care needs of the rural population. The activities PHC involve curative, preventive, primitive and family welfare services.

   Generally a medical officer, one female health assistant, a compounder, laboratory technician look after the Primary Health Can ters.

   You are appointed as an Architect to design a Primary Health Centre in a remote village having the proper space for different activities supposed to be performed there.
   Drawing required to a scale of (1:50)
   
   i) Bubble diagram/ Flow diagram
   (5)
   ii) Plan/ Plans
   (15)
   iii) Elevation/ View
   (10)
2012-13
B.TECH. /B.Arch. (ALL BRANCHES) WINTER SEMESTER EXAMINATION
STRENGTH OF MATERIALS
CE-101

Maximum Marks: 60 Credits: 04 Duration: Three Hours

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

Q.No. Question M.M.
1(a) Explain the following terms: (i) Strain hardening; (ii) Bulk modulus; (iii) Volumetric strain; (iv) Gauge length; (v) Modulus of rigidity. [06]
1(b) A mild steel bar 25mm diameter and 250mm long is placed inside a brass tube, having an external diameter of 30mm and internal diameter of 25mm. The combination is then subjected to an axial load of 45 KN. Find (i) the stress in the tube and the rod, (ii) the shortening of the rod. [06]

OR

1* An aluminium solid cylinder of 7.5 cm diameter fits loosely inside a steel tube having 10cm external diameter and 8 cm internal diameter. The steel tube is 0.02cm longer than aluminium cylinder and is 250cm long before the load is applied. Calculate the safe load which can be placed on a rigid flat plate on the top of the steel tube. Safe stress for steel is 95MPa and for aluminium 65 MPa. Take $E_s = 210GPa$ and $E_a = 70GPa$. [12]

2(a) A metal bar 5cm x 5cm section is subjected to an axial compressive load of 500 KN. The contraction on a 20cm gauge length is found to be 0.5mm and the increase in thickness 0.045cm. Find the value of Young’s modulus and poisson’s ratio. [03]

2(b) Draw the Mohr’s Circle for the state of stress shown in Fig. 1. Determine (i) the normal and shear stresses on the plane AC; (ii) resultant stress on the planes of maximum shear stress; and (iii) principal stresses and principal planes. [09]

Contd......2
2'(a) The state of stress at a point in a stressed material is given by \( \sigma_x = 20 \text{ MPa} \), \( \sigma_y = 10 \text{ MPa} \) and \( \tau_{xy} = 25 \text{ MPa} \). Determine the direction and magnitude of the principal stresses in the material. Also, locate the planes of maximum shearing stress and calculate the normal and shearing stresses on these planes.

2'(b) In a tensile test, a test piece 25mm in diameter, 200mm gauge length, stretched 0.0975mm under a pull of 50KN. In a torsion test, the same rod twisted 0.025 radian over a length of 200mm when a torque of 400N-m was applied. Evaluate the poisson's ratio and the three elastic moduli for the material.

3. Draw the shear force and bending moment diagrams for the beam shown in Fig.2. Also, locate the points of contra flexure in the beam if any.
4(a) Enumerate the assumptions made in simple theory of bending and obtain the bending equation.

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

OR

4' A beam of I-section 50 cm deep and 19 cm wide has flanges 2.5 cm thick and web 1.5 cm thick. It carries a shearing force of 400 KN at a section. Calculate the maximum intensity of shear stress in the section, assuming the moment of inertia to be 64500 cm⁴. Also calculate the total shear force carried by the web and sketch the shear stress distribution across the section.

5(a) Enumerate the assumptions made in the theory of pure torsion.

5(b) A solid aluminium shaft 100 cm long and of 5 cm diameter is to be replaced by a tubular steel shaft of the same length and the same outside diameter, so that either shaft could carry the same torque and have the same angle of twist over the total length. What must be the inner diameter of the tubular steel shaft? Modulus of rigidity of steel may be taken as 85 GPa and that of aluminium as 28 GPa.
2012-13
B.TECH. (WINTER SEMESTER) EXAMINATION
ELECTRONICS/COMPUTERS/ELECTRICAL/MECHANICAL/CIVIL/CHEMICAL/
Petrochemical
ENVIRONMENTAL STUDIES
CE111

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question M.M.
1(a) What is food chain? Give graphical representation of simple food model. [05]
1(b) Define environment and give its classification. [05]

OR

1’(b) Distinguish between Chemical Oxygen Demand and Biochemical Oxygen Demand. [05]
2(a) Write short notes on the following:
i) Photochemical Smog ii) Ozone Depletion [05]
2(b) What are the different sources of carbon monoxide? Discuss its adverse effect on human health. [05]
3(a) Describe briefly about the treatment scheme for surface water. [05]
3(b) Explain the disinfection process in water treatment process [05]
4(a) What are persistent organic pollutants? [03]

OR

4’(a) What are the harmful effects of heavy metals on human health? [03]
4(b) A mixture of domestic wastewater and river water has a 5 day, 20°C BOD of 15 mg/L rate constant equal to 0.3/d. Calculate its ultimate and 20 day BOD values. What will be its 3 day, 27°C BOD? Using Streeter–Phelps equation calculate the DO concentration in the stream after a time of travel of 3 days. Assume: stream temperature 20°C, stream reaeration rate constant as 0.6/d, saturation DO as 8.3 mg/L and initial deficit as 2.1 mg/L.

Contd.......2
5(a) Describe the working principle of cyclone separator and also explain how the radius of cyclone affects its efficiency.

OR

5'(a) Sketch the plume behavior for the following and also discuss the relationship with dry adiabatic lapse rate for each case
   i) Fanning
   ii) Looping
   iii) Loafting

5(b) Classify the particulate air pollutants.

6(a) Describe the different components of solid waste management.

6(b) Describe various thermal treatment processes for resource recovery from solid waste and explain any one of them in detail.
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. | Questions | M.M.
--- | --- | ---
1 | (a) Differentiate between volatile and non-volatile memory.  
(b) Differentiate between System Software and Application Software.  
(c) What are the five basic operations performed by the computer? Briefly explain.  
(d) What are the different functions of an operating system. List at least three most commonly used operating systems. | \[01\] \[01\] \[03\] \[03\]
2 | (a) Draw a flow chart for finding the following sum: \(1+2+4+7+11+...\) up to \(n\) terms  
(b) What are the primitive data types in C?  
(c) What will be the output of the following program  
`#include<stdio.h>`  
`#include<conio.h>`  
`void main()`  
`{`  
`printf("\n%d",1<2<3<4);`  
`printf("\n%d",1<3<2<4);`  
`}` | \[04\] \[02\] \[02\]

OR

2' | (a) Write an algorithm that prints the sum and average of a given set of \(n\) numbers.  
(b) What is the difference between post and pre ++ unary operator. e.g. ++i and i++  
(c) A ‘C’ program contains the following declaration:  
`char c;`  
`int i;`  
`float x;`  
Determine the data type for the following expressions  
(i) \(i + c\)  
(ii) \(x + c\) | \[04\] \[02\] \[02\]

Contd......
3 (a) A segment of ‘C’ program contains the following declaration:

```c
int i = 8, j = 5;
float x = 0.005, y = -0.01;
char d = 'd';
```

Compute the result for the following expressions:
(i) abs(i - 2*j)  
(ii) toupper(d)  
(iii) ceil(x)  
(iv) sqrt(x*x + y*y)

(b) With the help of an example show how a two dimensional array can be initialized.

(c) Write a program in C that determines if a given word is a palindrome or not. (a palindrome is a word which remains the same when read backwards)

OR

3' (a) Write a ‘C’ program to find the minimum among the three numbers a, b, c.

(b) What are the default input and output devices in C/C++ programming language.

(c) Write a program in ‘C’ to find the sum of the six terms of the following series using for loop. Call a function in the main program to calculate the factorial.

\[
\frac{1}{1!} + \frac{2}{2!} + \frac{3}{3!} + \frac{4}{4!} + \frac{5}{5!} + \frac{6}{6!}
\]

4 (a) Write a switch statement that will examine the value of an integer variable called flag and print one of the following messages depending on the value assigned to flag.

(i) HOT, if flag has a value of 1
(ii) LUKEWARM, if flag has a value of 2
(iii) COLD, if flag has a value of 3
(iv) OUT OF RANGE, if flag has any other value

(b) Write a program that will compute the sum of every third integer beginning with i = 2 i.e. sum of the series (2+5+8+...) for all values of i that are less than 100, using:

(i) while statement
(ii) do-while statement
(iii) for statement

5 (a) Differentiate between external and static variable. Do static variables retain their values even after exiting the function?

(b) Differentiate LAN and WAN. Give two examples of network topologies.
2012-13

B.TECH. /B.ARCH. (WINTER SEMESTER) EXAMINATION
(Civil/Electrical/Electronics/Computer/Chemical/Petro-Chemical & Mechanical Engineering)
Basics of Electrical & Electronics Engineering
EE-111

Maximum Marks: 60
Credits: 04
Duration: Three Hours

Answer all the questions.
Assume suitable data if missing.
Notations used have their usual meaning.
Part A (Q.No.1 & 2) and Part B (Q.No. 3 & 4) are to be attempted in separate copies.

Q.No. 1(a) Find the Thevenin’s equivalent parameters of the circuit shown in Figure 1 at terminals AB. Also find the Norton’s parameters thereafter.

![Figure 1](image)

Q.No. 1(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 500 W. Determine the efficiency at 75% full load and the maximum efficiency.

Q.No. 1(c) Using phasor diagram, obtain the relationship for line and phase current for delta connected system.

OR

Q.No. 1’(a) Differentiate between:
(i) Electrical and Magnetic circuits.
(ii) Form factor and Power Factor.

Q.No. 1’(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.

1'(c) Determine the currents applying Superposition theorem in the network shown in Figure 2.

![Figure 2]

2(a) Derive E.M.F equation for an alternator. Also write the modified equation incorporating winding factor.

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

2(c) Draw a power system network showing various voltage levels starting from transmission level to secondary distribution level.

**PART-B**

3(a) For the Zener diode network shown in Figure 3 determine \( V_L, V_R, I_Z \) and \( P_Z \) for:

   a) \( R_L = 1.2K\Omega \)
   b) \( R_L = 3K\Omega \)

![Figure 3]

3(b) Draw the output characteristics of the common emitter configuration. Define \( \beta_{dc} \) and \( \beta_{ac} \).

3(c) Draw the load line and Q point for the circuit shown in Figure 4. Show the effect of decreasing values of \( V_{CC} \) (i.e. \( V_{CC1} > V_{CC2} > V_{CC3} \)) on the load line and operating point.

Contd......
4(a) Explain how enhancement MOSFET works as a linear resistor. Also derive its expression. [05]

4(b) Explain the working of an Operational amplifier (OPAMP) based voltage follower. Why is it called a unity gain amplifier? [05]

4(c) What is virtual short and virtual ground in an operational amplifier? [05]

OR

4'(a) Explain $i_D-v_{GS}$ characteristics of a Depletion type MOSFET in the saturation region. What is $I_{DSS}$? [05]

4'(b) Design an inverting OPAMP circuit to form a weighted sum (summing) amplifier with two inputs $V_1$, $V_2$ and output $V_0$. It is required that $V_0 = -(V_1+5V_2)$. Choose values of $R_1$, $R_2$ and $R_F$ such that the maximum output voltage is 10V and the current in the feedback resistor should not exceed 1mA. [05]

4'(c) Derive the expression for the differential gain $A_{DM}$ and common mode gain $A_{CM}$ of an OPAMP based difference amplifier circuit.
Answer all the questions. 
Assume suitable data if missing.
Notations used have their usual meaning.

Q.No.  Question  M.M. 
1(a)  With the help of a circuit diagram, explain how zener diodes can be used as voltage regulators.  [05] 
1(b)  What are Rectifiers? With the help of a circuit diagram, explain the operation of a Bridge Rectifier.  [05] 
1(c)  A silicon junction diode with \( n = 1 \) has \( v = 0.7 \) V at \( i = 1 \) mA. Find the voltage drop at \( i = 10 \) mA.  [05] 

OR

1'(a)  What are clippers? With the help of a circuit diagram, explain the operation of a biased positive clipper.  [05] 
1'(b)  The circuit in Fig.1 utilizes three identical diodes having \( n = 1 \) and \( I_s = 10^{-14} \) A. Find the value of current \( I \) required to obtain an output voltage \( V_o = 2 \) V.  [05] 

Fig.1.
1(c) Determine the current $I_D$ and the diode voltage $V_D$ for the circuit shown in Fig.2. with $V_{DD} = 5 \text{ V}$ and $R = 1 \text{ K}\Omega$. Assume that the diode has a current of 1 mA at a voltage of 0.7 V and that its voltage drop changes by 0.1 V for every decade change in current.

![Fig.2](image)

2(a) Explain the operation of $npn$ transistor in the active mode of operation.

2(b) Analyze the circuit given in Fig.3 to determine the voltage at all nodes and currents through all the branches. Assume $R_1 = 100\text{ K}\Omega$, $R_2 = 50\text{ K}\Omega$, $R_C = 5\text{ K}\Omega$, $R_E=3\text{ K}\Omega$, $V_{CC} = 15 \text{ V}$ and $\beta = 100$.

![Fig.3](image)

2(c) Briefly explain the concept of Early Effect in Common Emitter configuration.

3(a) With the help of detailed characteristics, explain the operation of an enhancement type NMOS transistor.

3(b) Briefly explain the operation of a NMOS as a switch.
3(c) Design the circuit given in Fig. 4 to establish a drain voltage of 0.1 V. What is the effective resistance between drain and source at this operating point? Let \( V_t = 1 \text{V} \) and \( n \) \((W/L) = 1 \text{mA/\text{V}^2}\).

\[ V_{DD} = +5 \text{ V} \]
\[ I_D \]
\[ R_D \]
\[ V_D = +0.1 \text{ V} \]

Fig.4

4(a) Design an inverting op-amp circuit for which the gain is -5 \text{V/V} and the total resistance used is 120 \text{ K\Omega}.

4(b) Derive the expression of the differential gain of a single op-amp based Difference amplifier.

4(c) Write a detailed technical note on the principle of operation of Cathode Ray Oscilloscope (CRO).

OR

4'(a) Briefly explain the concept of Virtual Short.

4'(b) Derive the expression of closed loop gain for Inverting and Non-Inverting amplifier. Also find the values of their Input & Output resistance's.

4'(c) Write a detailed technical note on the measurement of phase difference with the help of a Cathode Ray Oscilloscope (CRO).
UNIT – I

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

References to psychology in the daily press and in popular periodicals are now numerous, but the variety of ideas as to the nature of psychology is correspondingly extensive.

The existence of so many varied conceptions of the nature of psychology is no doubt related to the many aspects of psychological work. The psychiatrist dealing with ‘mental’ breakdown, the educator moulding human development, the vocational counsellor advising on the choice of jobs, the social scientist studying the prevention of crime, the personnel manager smoothing human relations in industry, the industrial psychologist streamlining industrial processes to suit the nature of human capacities, all these are concerned with psychology. Human behaviour is varied and complex, and the science which studies it must have many aspects. It may by useful for us to consider a sample of psychological work:

The handling of modern planes places a severe strain on the pilot who must deal with many things in rapid succession. He has to keep watch on a number of dials which give him vital information about his speed, attitude, etc. It is essential that these dials should be easily read and not subject to error. What form should they take? They may have vertical scales or horizontal scales, they may be semicircular or round: the whole scale may be risible or only past through a small ‘window’. Only careful trials with a number of observers can establish which is the preferred form. An investigator (sleight) conducted some research to discover the best form for such dials and found that the windows type is the best. This seems reasonable since only a part of the scale appears in the window, and so there is less effort required to read the precise point on the scale, nut the psychologist has learned never to trust reasoning of this kind. Reasoning may suggest the answer, but we must always try it out.

Contd….2
(i) What is psychology?
(ii) Why are there varied conceptions of psychology?
(iii) List two disciplines concerned with psychology?
(iv) Why is handling planes stressful?
(v) Discuss sleights investigation into Reading Dials?
(vi) Give synonyms from the passage: vital, dial.

(b) Rewrite the following paragraph, putting and underlining the appropriate anomalous finites in the spaces according to the ideas given in brackets:
In addition to the errors mentioned in the reading passage, a scientific researcher _________ (possibility) commit other mistakes. For example, he _________ (remote possibility) fail to read all the relevant literature about the problem he is investigating. This _________ (physical ability) easily happen, especially in the fields of psychology or sociology; the investigator _________ (necessity) be extremely careful.

UNIT – II

2. (a) Discuss the disappointment of the Time-Travellers experiences of the year 802, 701 A.D.?

OR

‘The destiny of mankind is bleak’.
Discuss The Time Machine with reference to the above statement.

(b) Elucidate the dream of Old Major.

OR

Discuss the subversion of the revolution by the pigs led by Napoleon.

UNIT – III

3 Write a report on College Week celebration 2013.

OR

Write the process of purchasing an e-ticket for a round-trip to Bangalore.

Contd.....3
UNIT – IV

4. Read the following passage and thereafter make notes and write a precis of the same:

The world we live in presents an endless variety of fascinating problems which excite our wonder and curiosity. The scientific worker attempts to formulate these problems in accurate terms and to solve them in the light of all the relevant facts that can be collected by observation and experiment. Such questions as what? How? Where? And When? Challenge him to find the dues that may suggest possible replies. Confronted by the many problems presented by, let us say, an active volcano, we may ask: What are the leaves made of? How does the volcano work and how is the heat generated? Where do the laves and gases come from? When did the volcano first begin to erupt and when is it likely to erupt again?

Here and in all such queries What? refers to the stuff things are made of, and an answer can be given in terms of chemical compounds and elements. The question How? refers to processes – the way things are made or happen or change. The ancients regarded natural processes as manifestations of power by irresponsible gods, today we think of them as manifestations of energy acting on or through matter. Volcanic eruptions and earthquakes no longer reflect the erratic behaviour of the gods of the under world, they arise from the action of the earth’s internal heat on and through the surrounding crust.

UNIT – V

5. Write an essay on any ONE of the following topics in about 400 words:

(a) Technology and moral anxieties.
(b) A person I wish I knew ............
Maximum Marks: 60
Credits: 04
Duration: Three Hours


1(b) In a platinum resistance thermometer, the resistance varies with temperature as:

\[ R = R_0(1 + \alpha T + \beta T^2) \]

The resistance \( R \) is 10 ohm, 16 ohm and 30 ohm at ice point, steam point and sulphur point (444.6 °C) respectively. Find the resistance \( R \) at 500 °C.

2(a) Evaluate the magnitudes and signs of the heat transfer and of the work in the following processes. The system to be considered is printed in italics.

(i) A well insulated, sealed vessel contains 0.001 kg of fuel oil and some oxygen gas. The oil ignites, causing a rise in the temperature of the vessel and its content.

(ii) A sealed calorimeter containing powdered coal and oxygen gas is immersed in a tank containing 2 kg of water. In the first half minute after ignition of the coal, the water rises in temperature 0.03 K.

2(b) If \( a \) and \( l \) are the area and length of the indicator diagram, \( S \) is the spring number of the indicator spring, \( V_{sw} \) is the swept volume of the engine, establish the relation:

\[ \text{Work done per cycle} = \left( \frac{aS}{l} \right) V_{sw} \]

2(c) A gyroscope is set spinning and is placed inside a well-insulated rigid box; initially the gyroscope has a kinetic energy of 1000 N-m. Evaluate the increase in energy of the contents of the box when the speed of the gyroscope has fallen to zero.

Contd……..2
2(a) A 100 mm diameter vertical cylinder, closed by a piston, contains a combustible mixture at a temperature of 15 °C. The piston is free to move and its mass is such that the mixture pressure is $240 \times 10^3$ N/m$^2$; the upper surface of the piston is exposed to the atmosphere. The mixture is ignited. As the reaction proceeds, the piston moves slowly upwards and heat transfer to the surroundings takes place. When the reaction is complete and the temperature of the contents has been reduced to the initial value, 15 °C, it is found that the piston has moved upwards a net distance of 85 mm and that the magnitude of the heat transfer to the surroundings is 4 kJ. Evaluate the increase in the energy of the contents of the cylinder.

2(b) Apply SFEE to flow through an adiabatic nozzle and show the stagnation enthalpy remains constant during this flow.

3(a) Define pure substance and two property rule. How many work modes are relevant for a pure substance?

3(b) Define: $C_p$ and $C_v$ (give only mathematical expressions) and show that the heat transfer equals change of enthalpy in a constant pressure process.

OR

3' A turbine operates under steady flow conditions, receiving steam at the following state: Pressure 1.2 MPa, temperature 188 °C, velocity 33.3 m/s and elevation 3 m. The steam leaves the turbine at the following state: Pressure 20 kPa, dryness fraction 0.9, velocity 100 m/s, and elevation 0 m. Heat is lost to the surroundings at the rate of 0.29 kJ/s. If the rate of steam flow through the turbine is 0.42 kg/s, what is the power output of the turbine in kW?

4(a) Define a reversible engine and a reversible process.

4(b) Steam enters an adiabatic turbine at 6 MPa, 600 °C, and 80 m/s and leaves at 50 kPa, 100°C, and 140 m/s. If the power output of the turbine is 5 MW, determine (a) the reversible power output and (b) the isentropic efficiency of the turbine. Assume the surroundings to be at 25°C.

Contd.....3
4'(a) Define entropy and establish that only increases are possible in adiabatic processes.

4'(b) In a steady-flow closed-cycle gas-turbine engine, the temperature and velocity of the working fluid (air) between the components are as follows:

- Cooler and compressor: 30 °C, 90 m/s.
- Compressor and heater: 230 °C, 30 m/s.
- Turbine and cooler: 520 °C, 100 m/s.

The velocity of the air entering the turbine is 300 m/s and the heat transfer is \(642 \times 10^3\) J/kg. All heat transfers to the atmosphere may be assumed to be negligible.

Calculate:

(a) the temperature of the air at entry to the turbine.
(b) the heat transfer from the air in the cooler.
(c) the net work output of the plant.
(d) the efficiency.

Assume that the enthalpy of the air is a function of temperature only and that the specific heat at constant pressure \(C_p\) equals \(1.005 \times 10^3\) J/kg-K.

5(a) Very briefly explain, the Kirchhoff's law and Wein's Displacement law.

5(b) Hot air at a temperature of 60 °C is flowing through a steel pipe of 10 cm diameter. The pipe is covered with two layers of different insulating materials of thicknesses 5 cm and 3 cm. Their corresponding thermal conductivities are 0.23 and 0.37 W/m-K. The inside and outside heat transfer coefficients are 58 and 12 W/m²-K. The atmosphere is at 25 °C. Find the rate of heat loss from a 50 m length of pipe. Neglect the resistance of the steel pipe.
2012-13
B.TECH. (WINTER SEMESTER) EXAMINATION
I YR. B.TECH. (ALL BRANCHES)
ENGINEERING GRAPHICS
ME - 102

Maximum Marks: 60 Credits: 04 Duration: Three Hours

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

Q.No.  Question                                                                 M.M.  
1     A rectangular plot of 16 square kilometers is represented on a certain map by similar rectangle of area 1.0 square centimetre. Draw a plain scale to show unit of 10 kilometers and single kilometer, and long enough to read upto 60 kilometers. Find the R.F. of the scale. Also measure distances of 53 kilometers and 35 kilometers on it. [15]  
2     The projections of a line measure 80mm in the plan and 70mm in elevation. The mid-point of the line is 45mm infront of the V.P. and 35mm above the H.P. One end is 10mm infront of the V.P. nearer to it. The other end is nearer to the H.P. Draw the projection of the line and find its true length and inclination with the V.P. and the H.P. [15]  
2'    An equilateral triangle $\triangle ABC$ of 50mm side has its corner A 15mm above the H.P. and 20mm in front of the V.P. Its plane is inclined at 45 degrees to the H.P. Draw the projections of the triangle when:

i) The plan of the base AB is inclined at 30 degrees to the V.P. and ii) The base AB is inclined at 30 degrees to the V.P. [15]  
3     Draw the Elevation Plan and Left End View of a machine part shown in the figure given below:

![Machine Part Diagram](image-url) [15]  

OR

Contd......
3. Draw the Full Sectional Elevation, Plan and any End View of a machine part shown in the figure given below:

4. Orthographic view (Elevation and Plan) of an object in first angle method of projection is shown in the figure given below. Draw its Isometric Projection.
Answer all the questions. Assume suitable data if missing. Notations used have their usual meaning.

Q.No. Question M.M.
1(a) A transmission tower is held by three guy wires anchored by bolts at B, C and D. If the tension in wire is 1500N, determine the components of the force exerted by the wire on the bolt B. (refer figure 1).

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 figure 2)

Figure 1

Figure 2

OR

Contd......2
1'(b) The coefficients of friction are $\mu_s = 0.4$ and $\mu_k = 0.3$ between all surfaces of contact. Determine the force $P$ for which motion of the 30Kg block is impending if cable AB (a) is attached as shown (b) is removed. (refer figure 3)

![Figure 3](image)

2 The figure 4 shows a rectangular thin plate with a circular hole. For the axes shown determine (i) coordinates of centroid of the plate, (ii) the second moments $I_x$, $I_y$, $I_{xy}$ and (iii) the principle second moments of area and directions of principal axes through point O.

![Figure 4](image)

OR
2'(a) Determine the moments of inertia of the shaded area shown with respect to the x and y axes. (refer figure 5)

![Figure 5]

2'(b) The mechanism shown is acted by the force P. Derive an expression for the magnitude of the force Q required to maintain equilibrium. (refer figure 6)

![Figure 6]

3(a) A homeowner uses a snow-blower to clear his drive way. Knowing that the snow is discharged at an average angle of 40° with the horizontal, determine the initial velocity of the same. (refer figure 7)

![Figure 7]
3'(a) Knowing that the velocity of block B with respect to block A is \( V_{BA} = 5.6 \text{ m/s} \) at an angle of 70°, determine the velocities of A and B. (refer figure 8)

![Diagram of blocks A and B](image)

Figure 8

3(b) Two identical spheres A and B each of mass 'm' are attached to an inelastic, inextensible cord of length 'L', and are resting at a distance 'a' from each other on a frictionless horizontal surface. Sphere B is given a velocity \( v_0 \) in a direction perpendicular to line AB and moves without friction until it reaches B when the cord becomes taut. Determine (a) the magnitude after the cord has become has taut, (b) the energy lost as the cord becomes taut. (refer figure 9)

![Diagram of spheres A and B](image)

Figure 9

4 Two identical spheres A and B, connected by a cord of length 2c, can slide on a horizontal, frictionless surface. Initially the spheres are rotating counter clockwise at a rate of 8 rad/s about their mass center G, which is moving with a velocity \( v_0 \) in the direction shown in figure 14.51. Suddenly the cord breaks and the spheres are observed to move along straight-line paths with velocities \( V_A \) and \( V_B \) as shown. Knowing that the slopes of the paths are, respectively, \( K_A = 2 \) and \( K_B = 1 \), and the distance between the x
intercepts of the paths is \( d = 625 \text{mm} \), determine (a) the speeds \( v_a, v_A \) and \( v_B \) (b) the lengths \( 2c \) of the cord. (refer figure 10)

![Figure 10](image)

5(a) Knowing that crank \( AB \) has a constant angular velocity of 160rpm counter clockwise, determine the angular velocity of rod \( BD \) and the velocity of collar \( D \) when (a) \( \theta = 0 \) (b) \( \theta = 90^\circ \). (refer figure 11)

![Figure 11](image)

5(b) A 1m rod rests on a frictionless horizontal table. A force \( P \) of magnitude 2N is applied at \( A \) in the direction perpendicular to the rod as shown in figure 16.48. knowing that the rod weighs 0.8kg. (i) determine the acceleration of point \( A \) and \( B \). (ii) determine the
point of the rod AB at which force P should be applied if the acceleration of point B is to be zero. (refer figure 12)
2012-13
B.TECH. (WINTER SEMESTER) EXAMINATION
(ELECTRICAL/ELECTRONICS/MECHANICAL/COMPUTER/CHEMICAL/
PETROCHEMICAL ENGINEERING & B.ARCH.)
APPLIED MECHANICS
ME - 111

Maximum Marks: 60
Credits: 04
Duration: Three Hours

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

Q.No. Question M.M.
1 Represent the resultant of the force system acting on the pipe assembly (shown in [12]
Fig. 1) by a single force R at A and a couple M.

![Diagram of force system](image_url)

Fig. 1

OR

1'(a) A clockwise couple M is applied to the circular cylinder as shown in Fig. 2. [06]
Determine the value of M required to initiate motion for the conditions \( m_B = 3 \, \text{kg} \),
\( m_c = 6 \, \text{kg} \), \( \mu_B = 0.5 \), \( \mu_c = 0.4 \) and \( r = 0.2 \, \text{m} \). Neglect friction between the
cylinder and the block.

Contd. ....... 2
1(b) The spring of constant $k$ is unstretched when $\theta = 0$. Derive an expression for the force $P$ required to deflect the system to an angle $\theta$ as shown in Fig. 3. The mass of the bars is negligible.

![Fig. 2](image)

![Fig. 3](image)

2 Two small identical spheres A and B, connected by a cord of length $2c$, can slide on a horizontal, frictionless surface. Initially the spheres are rotating counterclockwise at a rate of $8$ rad/s about their mass center $G$, which is moving with a velocity $v_0 = v_0i$. Suddenly the cord breaks and the spheres are observed to move along straight-line paths with velocities $v_A$ and $v_B$ as shown in Fig. 4. Knowing that the slopes of the paths are, respectively, $k_A = 2$ and $k_B = 1$, and that the distance between the $x$ intercepts of the paths is $d = 625$ mm, determine (a) the speeds $v_0$, $v_A$ and $v_B$, (b) the length $2c$ of the cord.

Contd.....3
2'(a) A 5kg collar can slide without friction (shown in Fig. 5) 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.

2'(b) An 80 kg man and a 60 kg woman stand at opposite ends (shown in Fig. 6) of a 130 kg boat, ready to dive, each with a 5m/s velocity relative to the boat. Determine the velocity of the boat after they have both dived, if (a) the woman dives first, (b) the man dives first.
3(a) In the position shown in Fig. 7, bar DE has a constant angular velocity of 15 rad/s clockwise. Knowing that \( b = 600 \text{ mm} \), determine (a) the angular velocity of the bar FBD, (b) the velocity of point F.

![Fig. 7](image)

3(b) A uniform slender rod of length \( L = 900 \text{ mm} \) and mass \( m = 4 \text{ kg} \) shown in Fig. 8 is suspended from a hinge at C. A horizontal force \( P \) of magnitude 75 N is applied at end B. Knowing that \( r = 225 \text{ mm} \), determine (a) the angular acceleration of the rod, (b) the components of the reaction at C.

![Fig. 8](image)

4(a) Enumerate the assumptions made in the theory of pure torsion and obtain the Torsion Equation for a Circular Shaft as \( \frac{T}{I_p} = \frac{f}{R} = \frac{C\theta}{l} \).

Symbols have their usual meanings.

4(b) In a tensile test, a test piece 25mm in diameter, 200mm gauge length stretched 0.0975mm under a pull of 50KN. In a torsion test, the same rod twisted 0.025 radian over a length of 200mm when a torque of 400N-m was applied. Evaluate the...
poisson's ratio and the three elastic moduli for the material.

OR

4(a) Draw the Mohr's Circle for the state of stress shown in Fig. 9. Determine (i) the normal and shear stresses on the plane AC; (ii) resultant stress on the planes of maximum shear stress; and (iii) principal stresses and principal planes.

![Fig. 9](image)

4(b) A hollow circular shaft, 12m long is required to transmit 15MW when running at a speed of 300 r.p.m. If the maximum shearing stress allowed in the shaft is 80MPa and the ratio of inner diameter to the outer diameter is 3/4, find the dimension of the shaft and also the angle of twist of one end of the shaft relative to the other. Take Modulus of Rigidity of the material is 85GPa.

5(a) Draw Bending Moment and Shear Force Diagram for the beam shown in Fig.10. Also, locate the points of contra flexure in the beam if any.

![Fig.10](image)

5(b) A 4m long beam with rectangular section of 10 cm width and 10 cm deep is simply supported at the ends. If it is loaded with a uniformly distributed load of 4 KN/m throughout the span and a concentrated load P = 2 KN placed at a distance of 1.5 m from the left end, determine the maximum bending stress in the beam.