BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Common**

Subject: **Engineering Materials (GC205)/(GN205) [Rat/Rev]**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer any five of the following Questions: **5 x 3 = 15**

a) Write any three applications of tool steel.
b) Write the classification of bricks.
c) Differentiate between metals and non-metals.
d) Differentiate between acidic, basic & neutral refractories.
e) List any three high conductivity materials.
f) How are magnetic materials classified?
g) Write any three functions of lubricants.

Q.No.2. Answer any two of the following Questions: **2 x 6 = 12**

a) Define (i) Resistivity (ii) Conductivity (iii) Di-electric strength.
b) Write composition, properties and uses of: (i) Grey cast iron (ii) White Cast Iron.
c) Write short note on the properties and uses of Nickel-Chromium-Molybdenum steel.

Q.No.3. Answer any two of the following Questions: **2 x 6 = 12**

a) List and explain the composition, properties and uses of affects copper alloys.
b) List and explain the properties and uses of Duralumin and Al-Si alloys.
c) Write the composition, properties and uses of refractory bricks and fly–ash bricks.

Q.No.4. Answer any two of the following Questions: **2 x 6 = 12**

a) List any four types of cements. Write their composition and applications.
b) List any three abrasive materials. Write their properties and uses in brief.
c) Write short note on the composition, properties and uses of glass wool.

Q.No.5. Answer any two of the following Questions: **2 x 6 = 12**

a) Write any six characteristics of good insulating materials.
b) List and explain any six solid insulating materials.
c) Write short notes on (i) Nichrome (ii) Constantan. Also write any two applications of each of the above materials.

Q.No.6. Answer any two of the following Questions: **2 x 6 = 12**

a) What are the common varieties of timber? Write uses of wood products, veneer and plywood.

Only for students of Rationalised scheme:

b) Write short note on types of reinforcement materials and their applications.
c) What are the different constituents of paints? Explain any three constituents in detail.

Only for students of Revised scheme:

b) Write short note on gaseous insulating materials.
c) Write short note on vulcanisation process.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Common**

Subject: **Environmental Studies (GC203)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer any five of the following Questions: **5 x 3 = 15**

a) What is the need for environmental studies?
b) Explain the function of producers and decomposers in an ecosystem.
c) State the ten Biogeographical zones of India.
d) List the various sources of energy.
e) What is environmental audit?
f) Stat any six Human Rights.
g) What are the objectives of: (i) Environment Protection Act (ii) Wildlife Protection Act.
h) List any six rules to be followed under Motor Vehicle Act to prevent road accidents.

Q.No.2. Answer any two of the following Questions: **2 x 6 = 12**

a) Explain primary and secondary ecological succession.
b) (i) State the reason for loss of biodiversity. **(3)**
(ii) Explain In-Situ method for conservation of biodiversity. **(3)**
c) Describe Desert Ecosystem. **(Only for students of Rationalised scheme)**
c) Describe any one Ecosystem you have visited during field visit. **(Only for students of Revised scheme)**

Q.No.3. Answer any two of the following Questions: **2 x 6 = 12**

a) (i) What are the various causes of deforestation? **(3)**
(ii) State the effects of deforestation. **(3)**
b) Excessive use of synthetic pesticides in modern agriculture is a problem. Justify.
c) Discuss the effects of mining activities on the environment.

Q.No.4. Answer any two of the following Questions: **2 x 6 = 12**

a) (i) What are primary and secondary air pollutants? **(3)**
(ii) State the effects of air pollution on human health. **(3)**
b) Draw the flow sheet diagrams of primary and secondary treatment of waste water.
c) Explain the following methods of solid waste disposal:
(I) Sanitary land filling (ii) Composting

Q.No.5. Answer any two of the following Questions: **2 x 6 = 12**

a) Discuss the short term and long term effects of marine water pollution due to oil spills.
b) (i) State the major sources of noise pollution. **(3)**
(ii) State the effects of noise pollution on human health. **(3)**
c) What is Green House effect? Discuss the effects of Global Warming & Ozone Layer depletion.

Q.No.6. Answer any two of the following Questions: **2 x 6 = 12**

a) Write short notes on:
(i) Environmental Ethics
(ii) Environment Impact Assessment
b) What is sustainable development? State the guidelines for sustainable development.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Engineering & Technology**

Subject: **Engineering Maths-II (GC201)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer any five of the following Questions: **5 x 3 = 15**

a) Find the value of x if $\begin{vmatrix} 1 & 3 \\ 2 & x \end{vmatrix} = \begin{vmatrix} 4 & 1 \\ 2 & -1 \end{vmatrix}$

b) Find the values of a, b, c given $\begin{bmatrix} a-1 & 2b \\ c & 0 \end{bmatrix} = \begin{bmatrix} 3 & -1 \\ 4 & 0 \end{bmatrix}$

c) $\int \left(\sin 2x + \frac{1}{x} + e^{3x} \right) dx$

d) Evaluate $\int_0^1 (1-2x)dx$

e) Find $|\bar{a} - \bar{b}|$ for the vectors $\bar{a} = 3\bar{i} - 2\bar{j} - \bar{k}$ & $\bar{b} = \bar{i} + 2\bar{j} + \bar{k}$.

f) Obtain the mean deviation of 8, 9, 11, 12, 16. **(only for students of Mechanical Engg. & allied courses)**

f) Express the numbers z = 1 + i in its polar form. **(only for students of Electronics Engg. & allied courses)**

Q.No.2. Answer any three of the following Questions: **3 x 4 = 12**

a) Use Cramer's rule to solve:
3x + y + 2z = 3, 2x - 3y – z = -3, x + 2y + z = 4

b) Find A^{-1} given $A = \begin{bmatrix} 2 & 2 & 3 \\ 0 & -1 & 1 \\ 2 & 3 & 1 \end{bmatrix}$

c) Solve using the matrix method:
3x - 2y = 23, 2x – y = 14

d) Find $A^2 - 4A + 5I$ where $A = \begin{bmatrix} -1 & 4 \\ 2 & -3 \end{bmatrix}$

Q.No.3. Answer any three of the following Questions: **3 x 4 = 12**

a) $\int \frac{1}{x^2 - 6x - 16} dx$ **b)** $\int \frac{\tan(\log x)}{x} dx$ **c)** $\int_4^5 \frac{\sqrt{x-5}}{\sqrt{x-5} + \sqrt{4-x}} dx$

d) $\int_1^2 \frac{1}{x^2 + 9} dx$

Q.No.4. Answer any three of the following Questions: **3 x 4 = 12**

a) Obtain the projection of $\bar{a} + \bar{b}$ on $\bar{c}$ where $\bar{a} = \bar{i} + \bar{j} - 4\bar{k}$, $\bar{b} = \bar{i} + 4\bar{j} - 4\bar{k}$, $\bar{c} = \bar{i} + 3\bar{j} + \bar{k}$.

b) Find the area of a parallelogram whose adjacent sides are the vectors $\bar{a} = 3\bar{i} + 2\bar{j} + \bar{k}$ and $\bar{b} = \bar{i} + \bar{j} - \bar{k}$.

c) Given $\bar{a} = -3\bar{i} + \bar{j} + \bar{k}$, $\bar{b} = \bar{i} + \bar{j} + 3\bar{k}$ find i) $\bar{a} \cdot \bar{b}$ ii) $\bar{a} \times \bar{b}$.

d) Find the angle between the vectors $\bar{a} = \bar{i} - \bar{j}$, $\bar{b} = \bar{j} + \bar{k}$.

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Q.No.5. Answer any three of the following Questions: **3 x 4 = 12**

a) $\int \frac{1}{(2x-1)(x-3)}dx$ **b)** $\int \frac{\cos\sqrt{x}}{\sqrt{x}}dx$ **c)** $\int \frac{2x-5}{x^2-5x+6}dx$

d) Find the area bounded by the curve $y=x^2+1$, the x-axis and the lines $x=1$, $x=2$.

Only for students of Mechanical Engg. & allied courses:

Q.No.6. Answer any two of the following Questions: **2 x 6 = 12**

a) Calculate the median and the mode for the following frequency distribution:

Expenditure (in 1000's of Rs)	0-10	10-20	20-30	30-40	40-50
Frequency	14	23	27	21	15

b) Find the mean deviation taken from the A.M. for the following data:

Length of illness(days)	0-4	5-9	10-14	15-19	20-24	25-29
No. of patients	2	7	12	17	22	27

c) Calculate the standard deviation of the following data giving the maximum temperature in a city for 10 days as 30, 31, 29, 30, 32, 33, 32, 32, 32, 29 in degree Celsius.

Only for students of Electronics Engg. & allied courses:

Q.No.6. Answer any three of the following Questions: **3 x 4 = 12**

a) Given $\frac{3i^{11}+2i^4-i^3}{2i+1} = a+ib$, find a & b.

b) Use De Moivre's theorem to simplify $\frac{(\cos 2\theta + i\sin 2\theta)^{3/2}(\cos\theta - i\sin\theta)^3}{(\cos 3\theta - i\sin 3\theta)^2(\cos 5\theta - i\sin 5\theta)^{2/5}}$

c) Find the cube roots of unity.

d) Separate sin (x+iy) into its real & imaginary parts.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Engineering & Technology**

Subject: **Engineering Maths-I (GC102)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer any five of the following Questions: **5 x 3 = 15**

a) Find the centre and radius of the circle $x^2+y^2-10x+12y-7=0$

b) Find the area of sector of a circle with radius 9cm if the sector subtends an angle of 80° at the centre of the circle.

c) Find $\frac{dy}{dx}$ if $y=\log(\cos 5x)$.

d) Solve and state the nature of roots of $2x^2-3x-4=0$.

e) Find the volume of a prism having base an equilateral triangle of side 4cm and height of the prism is 12cm.

f) Divide x^3-2x^2+4 by $x-2$.

Q.No.2. Answer any three of the following Questions: **3 x 4 = 12**

a) Find the equation of a line passing through the point (4,5) and parallel to the line joining the points A(1,-4) and B(-2,5).

b) Find the equation of altitude AD of triangle ABC where A(1,5), B(2,-3) and C(5,1).

c) Show that the line $3x-4y+4=0$ touches the circle $x^2+y^2-2x+4y-4=0$.

d) Find the equation of a circle having centre as the point of intersection of the lines $2x+5y=9$ and $3x-y=5$ and having radius 4 units.

Q.No.3. Answer any three of the following Questions: **3 x 4 = 12**

a) If $\sin A=\frac{-3}{5}$, $\cos B=\frac{-5}{13}$, A and B lie in third quadrant, find $\sin(A+B)$.

b) Prove that $\frac{\sin 8x+\sin 6x}{\cos 8x+\cos 6x}=\tan 7x$.

c) In a ΔABC, if a=11cm, b=13cm and c=18cm solve the ΔABC.

d) Evaluate $\lim_{x\to 0}\frac{\left(e^{8x}-1\right)\left(4^x-1\right)}{x^2}$

Q.No.4. Answer any three of the following Questions: **3 x 4 = 12**

a) Evaluate $\lim_{x\to 3}\left[\frac{1}{x-3}-\frac{1}{x^2-5x+6}\right]$

b) Find the equations of tangent and normal to $y=2x^3+6$ at (1,5).

c) If the displacement 's' cm at time 't' seconds is $s=t^3-3t^2+4t+2$. When does the acceleration become 12 cm/sec²? Find the velocity at that time.

d) Find the maxima and minima for the function $y=x^3-6x^2+9x+4$.

Q.No.5. Answer any three of the following Questions: **3 x 4 = 12**

a) Find $\frac{dy}{dx}$ if (i) $y=\frac{\sec x}{x}$ (ii) $y=2^x+\log x+e^x+7$.

b) Find $\frac{dy}{dx}$ if $x^4+2y^3+3xy^2=0$

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c) Find $\frac{dy}{dx}$ if $x = \sin^3\theta$, $y = \cos^3\theta$.

d) Find $\frac{dy}{dx}$ if $y = x^{\tan x}$.

Q.No.6. Answer any three of the following Questions: **3 x 4 = 12**

a) Find x if (i) $\log_x 25 = 2$ (ii) $\log_2 8 + \log_2 (x+1) = 4$.

b) Find the volume of frustum of cone having radii of top and bottom faces 11cm and 16cm respectively. Slant height of the frustum is 13cm.

c) Find the volume and lateral surface of a pyramid whose base is a square of side 16cm and height of the pyramid is 15cm.

d) A plot of land has a straight boundary. The offsets drawn at a distance 1.5m apart from this boundary to a curved boundary of the plot are 5, 12, 18, 21, 23, 20, 15 and 8m. Find the area of the plot using Simpson's rule.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Engineering & Technology**

Subject: **Applied Chemistry (GC104)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer any five of the following Questions: **5 x 3 = 15**

a) Write the values of principal quantum number and azimuthal quantum number for 3p and 4d orbital.

b) Write two points of difference between temporary and permanent hard water.

c) Define degree of ionization. What are strong and weak electrolytes?

d) Why rough surfaces corrode faster than smooth surfaces?

e) Write any two points on how you will control corrosion by proper designing.

f) Define polymerisation. Write equation for polymerisation of tetrafluoroethylene to polytetrafluoroethylene.

Q.No.2. Answer any three of the following Questions: **3 x 4 = 12**

a) Explain the formation of sodium chloride molecule.

b) Write the orbital electronic configuration of phosphorus, neon, beryllium and calcium.

c) Distinguish between energy level and sub energy level.

d) Write four properties of electrovalent compounds.

Q.No.3. Answer any three of the following Questions: **3 x 4 = 12**

a) Write the disadvantages of using hard water in paper industry and bakeries.

b) Explain the electrodialysis process for desalination of brackish water.

c) Distinguish between scales and sludges.

d) In the zeolite process of water softening:
i) Write one reaction for removal of hardness of water.
ii) Write one limitation of the process.

Q.No.4. Answer any three of the following Questions: **3 x 4 = 12**

a) Explain the process of electrolysis of fused sodium chloride using carbon electrodes.

b) Write any two postulates of Arrhenius theory of electrolytic dissociation.

c) In the process of electrolysis of copper sulphate using platinum electrodes:
i) Write the reactions occurring at the cathode.
ii) Write the ions present in the solution.

d) With reference to the process of electrolysis of sodium chloride solution:
i) Write the reactions occurring at the anode.
ii) Why does the PH increase at the end of the process?

Q.No.5. Answer any three of the following Questions: **3 x 4 = 12**

a) Explain the process of metal spraying for protection of metal from corrosion.

b) Explain the types of oxide film formed in oxidation corrosion.

c) Distinguish between galvanising and tinning. (2 points)

d) Explain the oxygen absorption mechanism of electro-chemical corrosion.

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Q.No.6. Answer any three of the following Questions: **3 x 4 = 12**

a) Explain how you will control corrosion by dehumidification and alkaline neutralisation.

b) Write two points of difference between thermosetting and thermosoftening plastics.

c) What are monomers? How vinyl chloride is converted to poly vinyl chloride. Write the equation.

d) What is natural rubber? Write any three drawbacks of natural rubber.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Engineering & Technology**

Subject: **Applied Physics-II (GC202)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer the following Questions: **10x1.5=15**

a) Define Echo.
b) Define reverberation time.
c) The velocity of light in air is $3x10^8$ m/s and in water it is $2.4x10^8$ m/s. Calculate the refractive index of water.
d) Define luminous flux.
e) Define magnetic field intensity.
f) Define self induction.
g) If two resistances of values 10Ω and 15Ω are connected in parallel, then calculate the effective resistance.
h) Define internal resistance of a cell.
i) Convert 100μc into coulomb.
j) Write the expression for the effective capacitance when three capacitors are connected in parallel.

Q.No.2. Answer any four of the following Questions: **4 x 3 = 12**

a) Define electric field intensity and write an expression for it.
b) Draw the electric lines of force of a positive and negative charge.
c) Calculate the potential at a point, if a charge of 40μc is kept at a distance of 20m from it.
d) Three capacitors of values 5μf, 10μf and 20μf are connected in series. Calculate the effective capacitance. If a potential difference of 210 volts is applied across the combination then find the voltage drop across each capacitor.
e) Explain why the potential of the earth is considered to be zero.
f) Define:
i) Temperature coefficient of resistance
ii) One kilo watt hour

Q.No.3. Answer any four of the following Questions: **4 x 3 = 12**

a) State factors on which the resistance of a conductor depends on. Write an expression for specific resistance.
b) Derive an expression for general equation of Ohm's law with a neat diagram.
c) An electric iron is marked 150V and 600W. How much current is drawn by it and what is its resistance?
d) The resistance of a wire is 15Ω at 0°C and 20Ω at 70°C. Calculate its temperature coefficient of resistance.
e) A hostel has ten rooms. Each room consists of 2 bulbs of 60W each and one fan of 300W. Calculate the energy bill for June at the rate of 2.50 Rs. per unit.
f) With a neat diagram explain how a meter bridge can be used to determine an unknown resistance.

Q.No.4. Answer any four of the following Questions: **4 x 3 = 12**

a) Write an expression for the force acting on a straight current carrying conductor placed in a magnetic field and indicate what each term in the expression stands for.

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b) Distinguish between step up and step down transformer. (any four points)

c) Write an expression for the magnetic induction at the centre of a circular coil carrying current and indicate what each term in the expression stands for.

d) The magnetic induction at the centre of a circular coil 'n' turns of diameter 20cm placed in air and carrying a current of 2A is 5.01×10^{-4} wb/m^2. Calculate the number of turns in the coil. $\mu_o = 4\pi \times 10^{-7}$ H/m.

e) Explain Oersted's experiment and what are its conclusions?

f) A straight conductor of length 2m is placed at an angle of 30°, in a magnetic field of strength 3×10^{-2} wb/m^2. If the current flowing through the conductor is 5A, then calculate the force acting on the conductor.

Q.No.5. Answer any four of the following Questions: **4 x 3 = 12**

a) State Snell's law of refraction. If the angle of incidence is 30° and the angle of refraction is 20°, then calculate the refractive index.

b) State any four properties of X rays.

c) Calculate the time required for light to travel a distance of 500m in water if the refractive index of water is 4/3 and the velocity of light in air is 3×10^8 m/s.

d) Write two advantages and two disadvantages of optical fibres.

e) Explain the principle of Photometry.

f) Two lamps of 64 candelas and 16 candela are placed 2m apart. Determine the position of a screen in between them, where the screen will be illuminated equally.

Q.No.6. Answer any four of the following Questions: **4 x 3 = 12**

a) Explain how ultrasonic sound can be used for the process of depth sounding.

b) Draw waveforms to represent:
- i) High pitch wave
- ii) Low pitch wave

c) Distinguish between free and forced vibrations. Give one example of each type.

d) The velocity of a sound wave is 340 m/s. If its frequency is 400 Hz, then calculate the wavelength of the wave.

e) Define the following:
- i) Magnetic field
- ii) Luminosity

f) The balancing length of a potentiometer wire for a cell is 60 cm when the cell is in an open circuit. When a resistance of 4Ω is included in the circuit, the balancing length becomes 32cm. Calculate the internal resistance of the cell.

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BOARD OF TECHNICAL EDUCATION

PORVORIM-GOA

November, 2023 Examinations

Programme: **Engineering & Technology**

Subject: **Applied Physics-I (GC103)**

Time Duration: **3 Hrs.** Max. Marks: **75**

Instructions: 1) All questions are compulsory.
2) Figures to the right indicate full marks.
3) Assume suitable additional data if required.

Q.No.1. Answer the following Questions: **10x1.5=15**

a) State the Principal of Homogeneity.
b) What is a dimensional formula?
c) When is a body said to be having uniform acceleration?
d) Define one Newton.
e) What is banking of roads?
f) Define orbital velocity.
g) What is meant by critical velocity of liquid?
h) State two applications of surface tension.
i) What is areal expansion?
j) Define latent heat of vaporization.

Q.No.2. Answer any four of the following Questions: **4 x 3 = 12**

a) State the fundamental quantities, their units and symbols in SI system.
b) Check the correctness of the following equation:
$KE = \frac{1}{2} mv^2$ where KE= kinetic energy, m=mass, v=velocity.
c) Explain positive and negative error in micrometer screw gauge with neat diagram.
d) Deduce the dimension of coefficient of viscosity.
e) Convert the following from one system to other:
i) 10 $gm.cm^2/s^2$ into SI system
ii) 1600 kg/m^3 into CGS system
f) i) What is yield point?
ii) State Hooke's law.

Q.No.3. Answer any four of the following Questions: **4 x 3 = 12**

a) Give three points of distinction between speed and velocity.
b) Define kinetic energy. State the types of kinetic energy. Give two examples of kinetic energy.
c) A body is thrown vertically upwards with an initial velocity 30 m/s. Find the maximum height reached by the body and the time taken to reach it. (Take $g=10\ m/s^2$)
d) A vehicle is pulled along a highway with a uniform velocity of 72 km/hr exerting a force of 18KN. Calculate the work done in pulling the vehicle for 10 minutes.
e) Define: i) Retardation ii) Displacement.
f) A body weighing 400N is at a height 2.5m above the ground level and moving with a velocity of 2m/s. Calculate the total energy possessed by the body.

Q.No.4. Answer any four of the following Questions: **4 x 3 = 12**

a) i) Define radial acceleration.
ii) State the relation between angular and linear velocity.
b) A curved road of radius 200m is to be constructed such that the vehicle moving with velocity up to 72 km/hr can move along it safely. What should be the angle of banking?
c) Obtain an expression for acceleration due to gravity.
d) A tension of 200N is developed in a string of length 2.5m when a body is whirled in a horizontal circle with an angular velocity of 60 r.p.m. Calculate the mass of the body.

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e) Explain communication and remote sensing satellite.

f) Determine the time period of earth around the sun if the radius of orbit of the earth is 1.5×10^{11}m and mass of the sun is 2×10^{30} kg. ($G=6.67\times10^{-11}N.m^2/Kg^2$)

Q.No.5. Answer any four of the following Questions: **4 x 3 = 12**

a) Define Bulks Modulus. Obtain an expression for the same.

b) A body exerts a force of 200N on a steel wire of cross sectional area $5\times10^{-4}m^2$. Find the extension produced if the length of the wire is 4m and $Y=2\times10^{11}N/m^2$.

c) State Newton's law of viscosity. Write the necessary expression for force of viscosity and indicate what each term therein represents.

d) A capillary tube of radius 1.5mm is dipped in a liquid of density $1.2\times10^3kg/m^3$. The liquid rises by 1cm in the capillary tube. Calculate the angle of contact if the surface tension of the liquid is 0.15 N/m.

e) Define: i) Terminal velocity ii) Surface tension.

f) Calculate the viscous force acting on a spherical body of radius 4cm, falling in a liquid column with terminal velocity 15 cm/s and coefficient of viscosity 1.36 $N.s/m^2$.

Q.No.6. Answer any four of the following Questions: **4 x 3 = 12**

a) State the factors on which quantity of heat conducted at steady state depends upon. Write the expression for heat conducted and indicate what each term therein represents.

b) Calculate the temperature in degree Celsius required to change 15 litres of mercury at 90°C and 0.6 atmosphere pressure to 30 litres at 0.9 atmosphere pressure.

c) Define and explain convection with an example.

d) The length of a copper rod at 20°C is 1m. When heated to 80°C it increases by 0.2cm. Find coefficient of linear, areal and cubical expansion.

e) State and derive Gay Lussac's law.

f) i) What is variable state of a rod?
ii) State two engineering applications of expansion of solids.

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