BITS, Pilani-Dubai Campus
Knowledge Village

COURSE NO.: <u>TAUC211</u>;   COURSE TITLE: <u>Measurement Techniques-I</u>;
TIME: <u>2 hrs</u>;   MARKS: <u>80</u>   Date: 2nd Jan'05.

I.D. No._____

NAME:_____

RECHECK REQUEST:

PHYSICS

NOTE: (Answer all Questions, Data provided are complete. Some questions might have more than one correct answer. Mark all the right choices)

Please enclose the final answer of the numerical questions in a box ☐

Possibly for use

$\{c = 2.998 \times 10^8 \text{ m·s}^{-1}$; $\mu_0 = 4\pi \times 10^{-7} \text{ N A}^{-2}$; $\varepsilon_0 = 8.85 \times 10^{-12} \text{ F·m}^{-1}$;

$h = 6.63 \times 10^{-34} \text{ J·s}$; $e = 1.602 \times 10^{-19} \text{ C}$; $m_e = 9.1 \times 10^{-31} \text{ kg}$; $m_p = 1.67 \times 10^{-27} \text{ kg}\}$

- - - - - - - - - - - - - -

(e/m ratio)

1.   What will be the force 'F', when an electron of charge 'e' is ejected with velocity 'v' into a magnetic field 'B'.   [1]

Ans:

2.   In the above problem, derive an expression for a specific charge of an electron when velocity 'v' is perpendicular to uniform magnetic field 'B'   [3]

Ans:

(Planck's constant by photoelectric effect)

3.   Find the maximum kinetic energy in eV of photoelectron if the work function of the material is 2.45 eV and frequency of the incident radiation is 3.2×10^{15} Hz.   [2 ½]

Ans:

4.   Why do we need to use filters for certain colours? Mention any two colors of spectral lines for which a filter is used.   [2]

Ans:

(Diffraction over a single and double slit)

5.   A pattern which consists of a central bright maximum with secondary maxima and minima of gradually decreasing intensity is a _____ pattern.   [1]

6.   A pattern which consists of equally spaced maxima and minima within the central maximum is a _____ pattern.   [1]

(Induction of solenoids)

7.   The magnetic field 'B' inside a solenoid of 'n' number of turns per unit length carrying current 'i' is given as _____   [1]

8. A section of a solenoid of length L =15cm and having a circular cross-section of diameter D = 1.8cm carries a steady current of I = 4.20 A. The section contains 85 turns along its length. What is the inductance of the solenoid when the core is empty. [2 ½]

Ans:

(Electron Diffraction)

9. Neglecting the variation of mass with velocity, the wavelength associated with an electron having a kinetic energy E is proportional to E in the following way. [2]

Ans:

10. Lattice spacing in Potassium Iodide crystal is 0.35 nm. An electron beam shows first-order diffraction maximum at an angular position of 15.2° on a screen 6 cm away from the specimen. Calculate the potential applied to the electrons to get the corresponding electron beam. [2]

Ans:

4

(Fine structure of one-electron spectrum)

11.   Sodium light with wavelengths 588.99 nm and 589.59 nm is incident on a grating with 5500 lines per centimeter. A screen is placed 3.0 m beyond the grating. What is the distance between the two spectral lines in the first-order spectrum on the screen? In the second order spectrum?   [2]

Ans:

12.   Using the following data, plot a calibration graph and calculate the difference in the wavelength. The second order angular position of the two fringes of the doublet are $\theta_1 = 44.33°$ and $\theta_2 = 44.41°$. If the theoretical values of the two wavelengths are $\lambda_1 = 588.6$ nm and $\lambda_2 = 589.214$, what is the percentage error between the graphical value and theoretical value of the doublet?   [2]

Table 1: Wavelength of the He spectrum.

Color	Wavelength (nm)	Angle (°)
Red	667.8	23.45
Yellow	587.6	20.49
Green	501.6	17.34
Greenish blue	492.2	16.98
Bluish Green	471.3	16.26
Blue	447.1	15.37

Ans:

(Vibration of strings)

13. The next four problems concern the period of oscillation of a standing wave on a string. Assume that the fundamental mode of oscillation of the string has a period T_0. For each of the changes described below, give the factor by which the period changes. For example, if the change described resulted in a period twice as long, you would put the number "2" on your answer sheet. Do not cumulate changes. That is, before each change, assume you are back at the original starting situation. **[2]**

     I The mass density of the string is doubled.

     II The wave length of the starting shape is divided by three.

     III The amplitude of the oscillation is doubled.

     IV The tension of the string is halved.

Ans:

(RLC)

14. Which one of the following statements concerning the *impedance* of an *RCL* circuit is true? **[1]**

     A) The impedance is dominated by the capacitance at low frequencies.

     B) The impedance is dominated by the resistance at high frequencies.

     C) The impedance depends only on the values of C and L.

     D) The impedance depends only on the resistance.

     E) The impedance is independent of frequency.

15. When the frequency of an ac circuit is increased at constant voltage, the current increases and then decreases. Which combination of elements is most likely to comprise this circuit? **[1]**

     A) resistors only

     B) inductors only

C) capacitors only

D) a combination of inductors and resistors

E) a combination of inductors and capacitors

(Ferromagnetic Hysteresis)

16. Define retentively with proper diagram for a ferromagnetic material? **[2]**

Ans:

17. What is the difference between Ferro and Dia magnetic materials? **[2]**

Ans:

(Hall Effect)

18. A device used to measure magnetic fields makes use of the Hall effect. When in a magnetic field of 200G it gives a Hall voltage of $16\mu V$. If with the same current and orientation it gives a Hall voltage of $23\mu V$ in an unknown field, what is the magnitude of unknown field? **[2]**

Ans:

(Solar Cell)

19. Draw energy band diagram for a p-n junction clearly mentioning the Fermi level?

[2]

Ans:

(Elastic collisions)

20. Two identical balls collide head on. The initial velocity of one is 0.75m/s, while that of other is -0.43m/s. If the collision is perfectly elastic, what is the final velocities of each ball? [2]

Ans:

CHEMISTRY

1. Starch is a polymer of   [1]

   (a) Glucose   (b) Sucrose   (c) Both glucose and fructose
   (d) none of the above

2. Fehling's solution is an alkaline solution of   [1]

   (a) cupric ion complexed with sodium potassium tartrate
   (b) cuprous ion complexed with sodium potassium tartrate
   (c) cupric ion complexed with sodium tartrate
   (d) cuprous ion complexed with potassium tartrate

3. State giving chemical equations as to what happens when

   (a) oxalic acid is treated with Sodium bicarbonate solution.   [1]

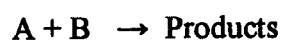(b) Tartaric acid is warmed with Tollen's reagent   [1]

4.   The specific rate constant for a first order reaction depends on the

_____   [1]

5.   A reaction between A and B is second-order.Write two different rate law
expressions for the reaction.   [1]

6.   The rate of a reaction

A + B → Products

is given as Rate = k [A] [B]
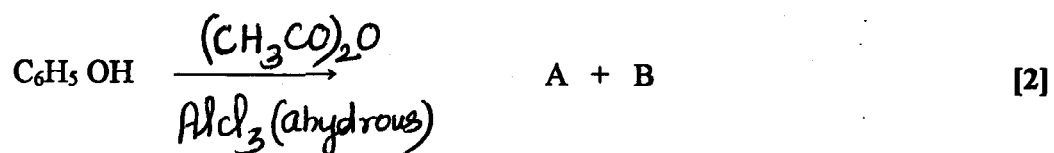If B is taken in large excess ,the order of reaction would be

(a) 2   (b) 1   (c) 0   (d) unpredictable.   [1]

7. How many milliliters of 0.020M $KMnO_4$ solution would be required to exactly titrate 25.00 mL of 0.2000M $Fe(NO_3)_2$ solution? [2]

8. Write the product of the following reaction.

$$C_6H_5\,OH \xrightarrow[AlCl_3\,(anhydrous)]{(CH_3CO)_2O} A + B$$ [2]

9. Represent the lewis acid and basic site in the reactants used in the preparation of acetanilide. [1]

10. Balance the following redox equation in acidic medium.

$$Cr_2O_7^{2-} + C_2H_4O \longrightarrow C_2H_4O_2 + Cr^{3+}$$ [2]

11. If 0.01 M solution of an electrolyte has a resistance of 40 ohms in a cell having a cell constant of 0.4 cm^{-1} then its molar conductance in $ohm^{-1} \, cm^2 \, mol^{-1}$ will be

(a) 10^4 (b) 10^3 (c) 10^2 (d) 10 [1]

12. Equivalent conductances of NaCl, HCl and CH$_3$COONa at infinite dilution are 126.45, 426.16 and 91 ohm^{-1} cm^2 equiv.$^{-1}$ respectively. The equivalent conductance of CH$_3$COOH at infinite dilution would be _____ [1]

13. What is the difficulty in using direct current for conductance measurements? [1]

14. The pH at the half way of stoichiometric point between the titration of a weak acid and a strong base is 5.5. Calculate the ionization constant of the acid. [1]

15. Sketch the pH curve for the titration of NH$_3$ Vs HCl. [1]

16. Give any 2 advantages of potentiometric titrations over indicator methods. [1]

BIOLOGY

1. Give the wave length at which the optical density of protein solution is measured?

    [½]

2. What should be the absorbance of blank solution in the spectrophotometer experiment for estimation of protein?

    [1]

3. Name the instrument used in the estimation of hemoglobin count and RBC, WBC count?

    [1½]

4. Which type of antigens & antibodies are present when an individual is having O blood group and AB blood group.

    [3]

5. Which one of these is the most common antigen for Rh factor?   [1]

    (a) A (b) B (c) I (d) D.

6. Elaborate BSA and tell in which experiment this is being used in the laboratory?

    [1]

7. Duration of mitosis is given by _____.

    [1]

8. If you take reading of micrometer eye piece as 20mm and it coincides with calibration slide reading of 33mm, what will be the calibration constant? (Give formula also)

    [2]

9. A technician in clinical lab. diluted a blood sample to 200times and counted 605 cells in 5 square grids of Neubar chamber, what are the cells he was counting and give the total count? (Give formula also)   [2]

10. A technician in clinical lab. diluted a blood sample to 20times and counted 125cells in 4 squares of Neubar chamber, what are the cells he was counting and give the total count?(Give formula also)   [2]

11. Chromosomes are most clearly visible in the cell cycle at   [1]
   (a) S phase because DNA replicate at that time.
   (b) G2 because DNA replication is over.
   (c) During metaphase because condensed chromosomes get streamlined at metaphase plate.
   (d) During Telophase as nuclear membrane get dissolve to reveal chromosomes.

12. In onion roots, mitosis in the somatic cells is found in _____zone.

13. Give one basic point of difference between Rhizopus and Aspergillus   [1]

14. On reaction between blood and N/10 HCL, the brown color is due to the formation of _____

[1]

15. Match the following (mark your answer within the brackets)

[1]

(a) Antibiotic   (i) Yeast

(b) Rods   (ii) Penicillium

(c) Spores   (iii) Fungi

(d) Bud   (iv) Bacillus

16. What is the difference between scanning electron microscope and Transmission electron microscope?
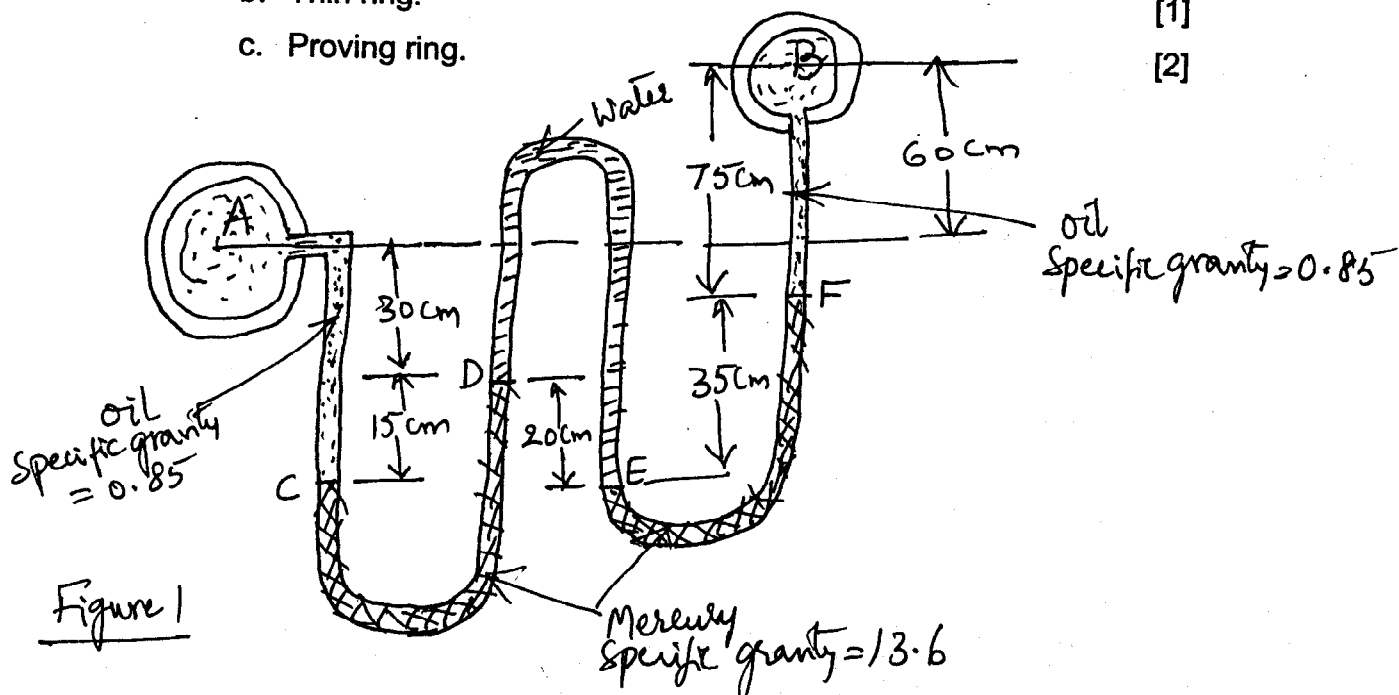
[1]

NOTES: TEST II (CLOSED BOOK) — REGULAR

1. Highlight all your answers by enclosing in boxes.
2. Assume any missing data suitably and mention the same at appropriate place in your answer.
3. All the parts of a particular question should be answered together.

1. Figure 1 shows a differential manometer connecting two oil pipe sections A and B. Calculate the pressure difference $p_A - p_B$ in kN/m^2. [5]

2. With appropriate derivations, explain how Bernoulli's equation is used to get

    a. Equation for flow rate in obstruction meters. [2]

    b. Equation for point velocity in pitot tube. [2]

3. Using a sketch explain how kinematic viscosity can be measured directly by using Saybolt viscometer. [3]

4. Write short notes on principles behind temperature measurements using

    a. Bimetallic strips. [2]

    b. Electrical resistance thermometer (RTDs). [2]

5. Using appropriate sketches explain how force is measured using the following elastic elements

    a. Cantilever beam. [1]

    b. Thin ring. [1]

    c. Proving ring. [2]

Figure 1

Water

60 cm

75 cm

oil Specific gravity = 0.85

oil Specific gravity = 0.85

30 cm

D

15 cm

20 cm

35 cm

F

C

E

Mercury Specific gravity = 13.6

BITS, PILANI – DUBAI CAMPUS, KNOWLEDGE VILLAGE, DUBAI
FIRST SEMESTER 2005 – 2006
TA UC 222 MEASUREMENT TECHNIQUES – II
TEST 1 (EEE Theory) (CLOSED BOOK)

MAXIMUM MARKS: 20

DATE:10.11.05

WEIGHTAGE: 20%

DURATION: 50 MINUTES

1A) Define the following terms with respect to measurement. [2M]
    i) Accuracy
    ii) Precision

1B) Mention any three advantages/ features of an electro static meter. [3M]

2. A large building mass behaves like a first order system when responding to a harmonic thermal input. If the harmonic input follows the pattern of daily heating and cooling (ie) one cycle occurs over a 24-hour period and the time delay is 3 hours, estimate the time constant. Also find how much the amplitude response decreases at this frequency. [5M]
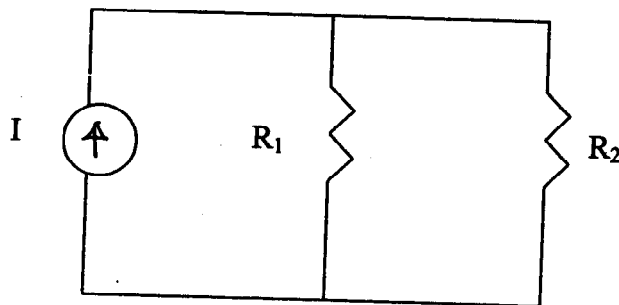
3. The measurement of power is to be conducted by measuring voltage across and current through the source with the circuit shown below. Calculate the nominal value of power delivered by the source and percentage of uncertainty for the following conditions: [5M]

$I = 10\ A \pm 2\%$
$R_1 = 500\ \Omega \pm 5\%$
$R_2 = 1000\ \Omega \pm 5\%$

4. i) Draw the diagram of Hay Bridge and write the formulas for Inductance L_x and Resistance R_x in the unknown arm. [3M]

   ii) If f = 1 kHz, $R_1 = 1.5\ K\Omega$, $R_2 = 3\ K\Omega$, $R_2 = 2\ K\Omega$ and C= 47μf, calculate L_x and R_x. [2M]