



श्री चित्रा तिरुनाल आयुर्विज्ञान और प्रौद्योगिकीसंस्थान, तिरुवनंतपुरम्-11
SREE CHITRA TIRUNAL INSTITUTE FOR MEDICAL SCIENCES & TECHNOLOGY
THIRUVANANTHAPURAM—695 011

ENTRANCE EXAMINATION - ACADEMIC SESSION JANUARY 2018

PROGRAMME: Ph.D. BIOENGINEERING STREAM

Time: 120 Minutes

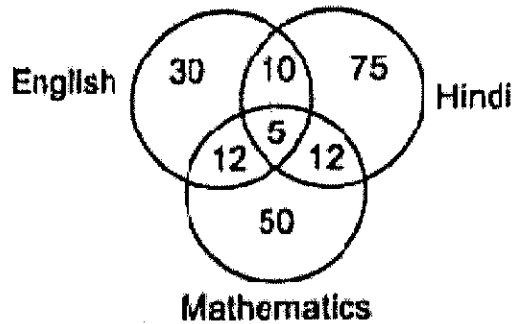
Max. Marks: 100

(Select the most appropriate answer)
(There are **no negative** marks for wrong answers)

- 1) If 'a' is the smallest prime number greater than 39 and 'b' is the largest prime number less than 10, then ab =
a) 299 b) 287 c) 229 d) 261
- 2) Find the odd number from the series 8, 64, 99, 216, 343, 729, 1728
a) 64 b) 216 c) 729 d) 99
- 3) Which of the following options is the closest in meaning to the word 'ephemeral'?
a) short-lived b) effeminate c) oppose d) ghostly
- 4) A person has the capability of thinking 100 lines of code in five minutes and can type 100 lines of code in 10 minutes. He takes a break for five minutes after every ten minutes. How many lines of codes will he complete typing after an hour?
a) 100 b) 250 c) 350 d) 600
- 5) GENEALOGY: ANCESTRY, ETYMOLOGY: _____
a) Words b) Insects c) Fossils d) Inscriptions
- 6) Complete the equation by correctly identifying the incomplete number of the calculation from the list of options given below.
Equation: $(4.25 + 2.75)^2 + \underline{\quad} = 5^3 - (9 \times 8)$
a) 2 b) 4 c) 6 d) 8
- 7) Cobalt-60 is used in the radiation therapy of cancer and can be produced by bombardment of cobalt-59 with which of the following?
a) Neutrons b) Alpha particles c) Beta particles d) X-rays
- 8) When you reverse the age of the father you will get the age of the son. One year ago the age of the father was twice that of son's age. What are the current ages of son and father?
a) 37 and 73 b) 24 and 42 c) 13 and 31 d) 15 and 51

- 9) Which of the following microorganism does not cause disease in human beings?
 a) *Vibrio cholerae* b) *Salmonella typhi* c) *Clostridium tityani* d) *Brevibacterium linens*
- 10) The anhydride of $\text{Ba}(\text{OH})_2$ is
 a) BaOH b) BaO c) BaO_2 d) Ba
- 11) Inheritance of acquired characteristics is called _____
 a) Lamarckism b) Neo-Lamarckism c) Mendelism d) Darwinism
- 12) A buffer is made from equal concentrations of a weak acid and its conjugate base. Doubling the volume of the buffer solution by adding water has what effect on its pH?
 a) It has little effect.
 b) It significantly increases the pH
 c) It significantly decreases the pH
 d) It changes the pH asymptotically to the pKa of the acid.
- 13) All proteins absorb electromagnetic radiation of wavelength around 190 nm, which corresponds to an excitation in the protein molecule. In which region of the spectrum is this wavelength found?
 a) X-ray b) Ultraviolet c) Microwave d) Infrared
- 14) What will be the pH of 10^{-8} M HCl?
 a) 7.22 b) 7.14 c) 7.0 d) 6.98
- 15) Which of the following is not having an electromagnetic nature?
 a) X-rays b) UV-rays c) β -rays d) Microwave
- 16) Which number comes next in this sequence? 1, 1.5, 2.5, 4, _____?
 a) 9 b) 8 c) 7 d) 6
- 17) If 3 less than twice a certain number is equal to 2 more than 3 times the number, then 5 less than 5 times the number is
 a) -30 b) -20 c) -5 d) 0
- 18) What is the greatest value of x for which $(3x-2)(x+1) = 0$?
 a) -1 b) $-\frac{2}{3}$ c) $\frac{2}{3}$ d) 1
- 19) If the average of 5 numbers is 36 and the average of four of those numbers is 34, then what is the value of the fifth number?
 a) 2 b) 34 c) 35 d) 44
- 20) The surface tension of a liquid vanishes at
 a) triplet point
 b) the boiling point
 c) critical temperature
 d) none of the above

21) Five hundred candidates appeared for the test conducted for English, Mathematics and Hindi. The below diagram gives the number of candidates failed at different tests. What is the percentage of students who failed for at least two tests?



- a) 0.078% b) 1.0% c) 6.8% d) 7.8%

22) A worker may claim Rs15 for each km he travelled in taxi and Rs 5 for each km he travelled in his own car. If in a month he is claiming Rs 500 for travelling 80km, how much does he travelled by taxi?

- a) 10 b) 20 c) 70 d) 40

23) At the end of a business conference ten people shook hands each other. Then how many handshakes were there altogether?

- a) 100 b) 55 c) 10 d) 45

24) A number of people decided to go to picnic and spent Rs.96 on eatables. At the end, four people did not turn up. As a result, others had to contribute Rs. 4 each extra. The number of those who attended the meeting was

- a) 12 b) 8 c) 10 d) 6

25) A bus starts from city X. The number of women in the bus is equal to half the number of men in the bus. When the bus reached city Y, 10 men left the bus and 5 women boarded it. Now, the number of women and men in the bus become equal. If so, how many passengers entered the bus in the beginning from city X.

- a) 15 b) 30 c) 36 d) 45

26) Today is Wednesday, after 62 days it would be

- a) Monday b) Tuesday c) Wednesday d) Saturday

Choose the appropriate word closest to meaning of word given in italics (questions 27 & 28)

27) A *baffling* problem

- a) Simple b) Puzzling c) Difficult d) Fresh

28) *Posthumous* child

- a) illegitimate b) Brilliant c) Born after death of father d) physically weak

Choose the appropriate word closest to meaning of word given in italics (questions 29 to 32)

29) *Hooligan*

- a) Tin Whistle b) Thug c) Street gang d) commotion

30) *Modus vivendi*

- a) Way of work b) Way of life c) Way of Operation d) Way of game

31) *Elucidate*

- a) Clarify b) Interpret c) Confuse d) Contradict

32) *Claustrophobia*

- a) Fear of spider b) Fear of computers c) Fear of being in enclosed area d) Fear of foreigners

33) The length of the side of a square is represented by $x+2$. The length of the side of an equilateral triangle is $2x$. If the square and the equilateral triangle have equal perimeter, then the value of x is

- a) 3 b) 5 c) 6 d) 4

34) The area of the circle is increasing at the rate of $0.7 \text{ cm}^2/\text{sec}$. What is the rate of increase of its circumference?

- a) 0.84 b) 1.4 c) 0.7 d) 1

35) The frequency of the second harmonic of 60 Hz is:

- a) 60 Hz b) 180Hz c) 100Hz d) 120Hz

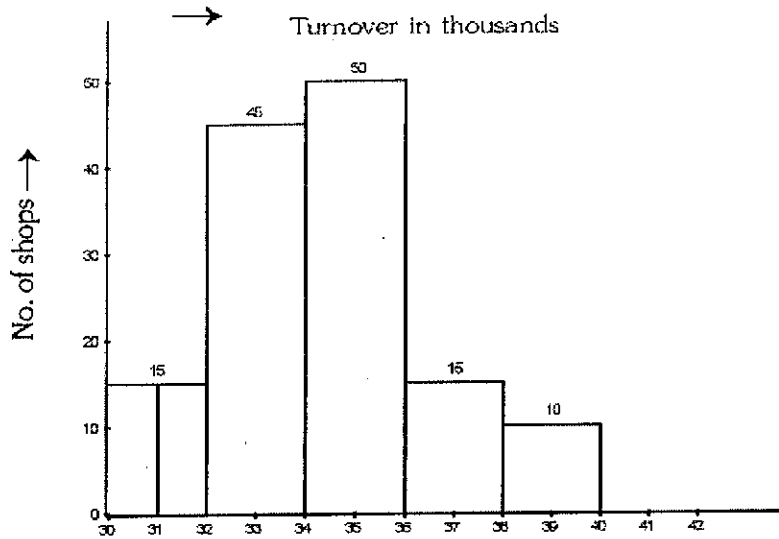
36) If $a - b = 3$ and $a^2 + b^2 = 29$. Find the value of ab .

- a) 10 b) 12 c) 15 d) 18

37) An accurate clock shows o'clock in the morning. Through how many degrees will the hour hand rotate when the clock shows 2 o'clock in the afternoon?

- a) 144° b) 160° c) 168° d) 180°

The results of a survey done on the monthly turnover of some shops are represented as a bar diagram below. Study the chart carefully and answer the questions 38 & 39.



- 38) What percentage of shops has turnover of over Rs.36000
 a) 20% b) 25% c) 5% d) 23%
- 39) How many shops have turnover between Rs.32000 and Rs.38000?
 a) 35 b) 95 c) 110 d) 55
- 40) Find the word which is nearly opposite in meaning for the word "Extrinsic"
 a) Severe b) Shallow c) Incidental d) Inherent
- 41) A spectrophotometer is used to measure the concentration of a molecule in a solution based on Beer's law, using a cuvette of path length 10 mm and detectable absorbance of 0.01. The molar absorptivity of the solution is 10^4 L/mol/m. The minimum detectable concentration of the solution is.....
 a) 1μ mol/L b) 2μ mol/L c) 5μ mol/L d) 10μ mol/L
- 42) The resistance of a photoresistorwith the increase in the illumination
 a) decreases exponentially b) decreases linearly
 c) increases exponentially d) increases linearly
- 43) In Fick's method of cardiac output measurement, oxygen consumption is 200 mL/min, arterial oxygen content is 0.30 mL/mL and venous oxygen content is 0.20 mL/mL. The cardiac output is L/min is
 a) 1.0 b) 2.0 c) 0.5 d) 1.5
- 44) Michelson's interferometer utilizes the principle of
 a) amplitude splitting b) interference
 c) FSK d) none of the above

- 45) The resolving power of a telescope is proportional to
 a) λ b) λa c) a/λ d) λ/a^2
- 46) In an electromagnetic blood flow meter, the induced voltage is directly proportional to the
 a) logarithm of the blood flow rate b) square root of blood flow rate
 c) square of blood flow rate d) blood flow rate
- 47) Interferometer is used for the measurement of
 a) wavelength b) thickness of thin strips
 c) velocity d) Both (a) and (b)
- 48) At 0K, which of the following properties of the gas will be zero?
 a) Kinetic energy
 b) Potential energy
 c) Vibration energy
 d) Density
- 49) Diastolic blood pressure of normal human in mm Hg
 a) 80-120 b) 30-60 c) 0-30 d) 60-90
- 50) A single-sensor, contact type ultrasonic flow detector uses a frequency of 330 kHz. When testing a specimen an echo from a flow is recorded 0.5 ms after the transmitted pulse. If the velocity of the sound in the test object is 600 m/s, then the flow is at a depth of
 a) 120 cm b) 60 cm c) 30 cm d) 15 cm
- 51) Two coils of self inductance of $50\mu\text{H}$ each are placed close together that the effective flux in one coil is completely linked with the other. What is the mutual inductance between them?
 a) $1\mu\text{H}$ b) $100\mu\text{H}$ c) 1mH d) $50\mu\text{H}$
- 52) Bourdon tube is used for the measurement of gauge pressure of
 a) Gas b) Liquid c) Solid d) Both a & b
- 53) Acoustic impedance is measured in
 a) Rydberg b) Ohm c) Rayl d) Rads
- 54) Number of electrodes affixed to a body in 12 lead ECG are
 a) 12 b) 10 c) 4 d) 5
- 55) What is the dispersive power of a prism to separate 2 lines of wavelengths 5997 \AA and 6003 \AA ?
 a) 0.003 b) 0.002 c) 0.001 d) 0.004
- 56) Two crossed polarizers are placed in the part of light beam. The light output is
 a) Zero b) Plane polarized c) circularly polarized d) elliptically polarized
- 57) In an inductor of self inductance 2mH , the current changes with time according to relation $i = t^2 e^{-t}$. At what time, the voltage across inductor becomes zero?
 a) 4 sec b) 3 sec c) 2 sec d) 1 sec
- 58) If the half life of a radiation source is 1 yr, its decay constant per year is
 a) 1 b) 2 c) 0.693 d) 63.2

- 59) In laser, the process of creating a population inversion by supplying energy to the medium is called
 a) Trimming b) Optical resonator c) Q-Switching d) Pumping
- 60) An electromagnetic flowmeter with a peak magnetic flux density of 100mT is used to measure a flow velocity of 100 mm/s in a pipe of diameter 50mm. Output of the flowmeter is connected to an amplifier with $1M\Omega$ input impedance and gain 1000. If the impedance of the liquid between the electrodes is $100k\Omega$, then the value of the amplifier output voltage
 a) 5.0 V b) 0.05 V c) 0.045V d) 0.45 V
- 61) For an optical fibre to gather all the light falling on it, its Numerical Aperture should be
 a) <1 b) >1 c) $=1$ d) Zero
- 62) A basic generalized form of comparator is _____.
 a) Zero-Crossing Detector b) Sine to Square Wave Generator
 c) Both A & B d) None of the above
- 63) Which of the following is not a part of laser process action?
 a) Absorption b) Stimulated emission c) Spontaneous d) Refraction
- 64) In a cardiac output measurement set-up using thermo-dilution principle, the change in output temperature is 7°C for 5.60 L/min of cardiac output with an integration time of 10 s. For a second measurement the change in temperature is 10°C with an integration time of 20s; without any change in other parameters. The cardiac output in L/min for this is.....
 a) 1.96 b) 4.21 c) 3.92 d) 5.60
- 65) The resting membrane potential of a cell is approximately.....
 a) -70 mV b) 30 mV c) -100 mV d) -30 mV
- 66) Cardiac output is
 a) the amount of air pumped by lungs per minute
 b) the amount of air pumped by lungs per second
 c) the amount of blood delivered by the heart to the aorta per second
 d) the amount of blood delivered by the heart to the aorta per minute
- 67) In CT Scanner, attenuation coefficient of water is 0.205 and that of heart muscle is 0.212, find the Hounsfield number of heart muscle
 a) 405 b) 205 c) 34 d) 17
- 68) Light from a 50Hz mains powered fluorescent lamp is falling on a gear rotating clockwise. The gear wheel has one tooth painted white. The white tooth appears to be rotating in the anti-clockwise direction with a speed of 80 rpm, the true speed of the gear wheel is
 a) 2920 rpm b) 3080 rpm c) 4920 rpm d) 4960 rpm
- 69) In relation to incandescent optoelectronic devices, MSCP refers to
 a) Mean Spherical Candle Phototube b) Mono Spherical Candle Phototube
 c) Mean Spherical Candle Power d) Mono Spherical Candle Power

- 70) When a beam of light having wavelength 6000 \AA travelling in air enters a glass medium of refractive index 1.5, the wavelength changes to
 a) 2000 \AA b) 3000 \AA c) 4000 \AA d) 5000 \AA
- 71) Find the thickness of the tissue which attenuate the incident beam of X-ray to $1/20$ of the initial value when the attenuation coefficient of the tissue is 1.62 cm^{-1}
 a) 1.35 cm b) 2.05 cm c) 1.85 cm d) 2.75 cm
- 72) A blood sample of a patient has a packed cell volume of 0.40 and the RBC count is found to be 5 million /microliter; what is the mean cell volume
 a) 90 fL b) 80 fL c) 20 fL d) 45 fL
- 73) A radioactive compound with a half life of 6 min is injected into the blood stream of patient for diagnostic purpose. The detector works only if the quantity of the compound is more than $1 \mu\text{g}$. If $4 \mu\text{g}$ of sample were injected, then the maximum time within which the diagnosis of the patient should be completed is
 a) 3 min b) 12 min c) 6 min d) 18 min
- 74) The limit of resolution of human eye is approximately
 a) 1° b) $1'$ c) 1 mm d) 1 cm
- 75) An ultrasonic beam of frequency 1 MHz and intensity 0.5 W/cm^2 passes through a layer of soft tissue of thickness, 't' with an attenuation coefficient of 1.18 cm^{-1} . The ratio of output to input power is $1/e^2$. The thickness of the tissue is:
 a) 1 cm b) 1.695 cm c) 2.408 cm (d) 3.721 cm
- 76) Find the resistance of a CdS cell after 10 ms of application of a day light beam. (Dark resistance = $100 \text{ k}\Omega$, resistance at day light beam = $30 \text{ k}\Omega$ and the time constant = 72ms).
 a) $38.6 \text{ k}\Omega$ b) $39.1 \text{ k}\Omega$ c) $41.2 \text{ k}\Omega$ d) $28.1 \text{ k}\Omega$
- 77) LVDT , an instrument for the measurement of displacement works on the principal of
 a) Linear inductance b) Non - linear inductance
 c) Mutual inductance d) Linear capacitance
- 78) EEG is commonly used in the study of
 a) muscle excitation b) epilepsy c) hydrocephalus d) None of the above
- 79) What is the cut-off voltage or the minimum voltage above which light emission takes place in case of an LED?
 a) 0.7 V b) 1.3 V c) 0.3 V d) 1.0 V
- 80) The P wave of the ECG waveform correspond to
 a) depolarisation of atria b) depolarization of ventricles
 c) repolarisation of atria d) repolarisation of ventricles
- 81) Speed of sound through a medium depends on
 a) wavelength of the source b) constant in any medium
 c) properties of the medium d) None of the above
- 82) Spirometer is used to measure
 a) lung capacity b) cardiac output
 c) heart rate d) blood pressure

- 83) The T wave of the ECG waveform correspond to
 a) depolarization of ventricles b) depolarisation of atria
 c) repolarisation of atria d) repolarisation of ventricles
- 84) The transmittance of a particular solution measured is T. The concentration of the solution is now doubled. Assuming that Beer–Lambert’s law holds good for both the cases, the transmittance for the second would be
 a) $T/2$ b) T^2 c) $2T$ d) \sqrt{T}
- 85) Cell count of blood can be estimated by
 a) Geiger counter b) Coulter counter c) treadmill test d) beam balance
- 86) Which of the following relates to a photodiode?
 a) photo voltaic device while working with or without reverse voltage
 b) photo conductive device while working without a reverse voltage
 c) photo conductive device while working with reverse voltage
 d) None of the above
- 87) Range of infrared LED is
 a) 5600 Å to 7000 Å b) 12 Å to 7000 Å
 c) 5600 Å to 9000 Å d) 1.2 μm to 7000 Å
- 88) Find the loss in optical fibre (dB/km) for 80% transmission/km
 a) 3 dB/km b) 2 dB/km c) 1 dB/km d) 4 dB/km
- 89) Colour appears on a thin soft film is due to the phenomenon of
 a) refraction b) dispersion c) interference d) diffraction
- 90) Korotkoff sounds are used for
 a) reference of sound level measurement b) studying heart muscle functioning
 c) blood pressure measurement d) study of heart valve functioning
- 91) Cardiac output of a patient is measured with an indicator dilution method by injecting 10 mg indicator in to blood stream. The average concentration of the indicator calculated from the dilution curve is 5 mg/L for curve duration of 20s. Find the cardiac output
 a) 2 L/min b) 3 L/min c) 10 L/min d) 6 L/min
- 92) Action potential of a cell is approximately.....
 a) 70 mV b) -20 mV c) +20 mV d) -50 mV
- 93) The current gain of a transistor in CB mode is 0.95. Then its value in CE mode is
 a) 0.95 b) 1.5 c) 19 d) 1/19
- 94) The cardiac output is measured with the help of indicator dilution method. The quantity of indicator injected is 20 mg and the area under the die dilution curve is found to be 180 mg s/L. Find the cardiac output
 a) 6 L/min b) 6.66 L/min c) 8 L/Min d) 8.66 L/min
- 95) Haemoglobin concentration of a blood sample is 15g/dL and a PCV is 0.45. Find the mean cell haemoglobin concentration for the blood sample
 a) 33.3 g/dl b) 7.5 g/dl c) 8.25 g/dl d) 27.3 g/dl

- 96) Find the wavelength of scattered X-rays in Compton scattering of wavelength 3\AA and scattered at 30° angle w.r.t. incident beam
a) 3.005678\AA b) 2.005678\AA c) 4.005678\AA d) 5.005678\AA
- 97) An LED is connected to a 10 V power supply through $R_s = 470\Omega$. What is the maximum value of LED current if the minimum voltage drop is 1.5 V in the LED.
a) 3.2 mA b) 18.1 mA c) 21.3 mA d) 20.1 mA
- 98) What will be the output voltage of an Op-amp inverting adder for the input voltages $V_1 = -10\text{ V}$, $V_2 = +10\text{ V}$, $V_3 = +5\text{ V}$ and resistances $R_1 = 600\text{ K}\Omega$, $R_2 = 3000\text{ K}\Omega$ & $R_3 = 2\text{ M}\Omega$ if the feedback resistance is considered to be $2\text{ M}\Omega$?
a) -38.3 V b) 38.3 V c) 40 V d) -40 V
- 99) In an amplifier the input signal of $100\mu\text{ V}$ is corrupted by a common mode noise of 1 mV . The output of the amplifier contains 100 mV of signal and 0.01 mV of noise. The CMRR of the amplifier is
a) 40 dB b) 60 dB c) 80 dB d) 100 dB
- 100) An experiment requires reduction of the power of $250\text{ keV}\gamma$ -ray to 10% by passing through a copper plate. If the half value layer of copper is 2.0 cm . Then, what is the thickness of the required sheet?
a) 3.6 cm b) 6.7 cm c) 9.5 cm d) 5.4 cm