

SECTION A

PART I - Multiple Choice Questions (30 Marks)

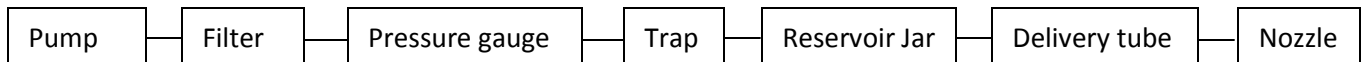
Choose the correct answer and write down the letter of the correct answer chosen in the Answer Booklet against the question number. E.g. 31 (c). Each question carries ONE mark. Any double writing, smudgy answers or writing more than one choice shall not be evaluated.

1. EEG (Electroencephalogram) records the electrical activity of:
 - a. The muscle
 - b. The heart
 - c. The brain
 - d. The lungs
2. Which of the following equation is true:
 - a. KVA (Apparent power) = KW (useful power) x Power factor ($\cos \theta$)
 - b. $KW = KVA \times \cos \theta$
 - c. $\cos \theta = KW \times KVA$
 - d. None of the above
3. Which of the following element is used in conventional Sphygmomanometers:
 - a. Silver
 - b. Platinum
 - c. Cadmium
 - d. Mercury
4. The application of telecommunication and computer technology to deliver health care from one location to another is:
 - a. Telemetry
 - b. Telemedicine
 - c. Teletherapy
 - d. Teleconsultation
5. Which of the following radioactive decay produces radiation?
 - a. β^+ (Positron Decay)
 - b. Electron capture
 - c. Isomeric Transition
 - d. All of the above

6. Range of 1 – 5 MHz frequency in Ultrasound is used for scanning:
 - a. Abdominal examinations
 - b. Bones
 - c. Superficial organs
 - d. Heart and lungs


7. The development of dual-chamber and multi-programmable pacemakers necessitated a more detailed nomenclature, resulting in the revision of the three letter code to:
 - a. Four letter codes
 - b. Five letter codes
 - c. Six letter codes
 - d. Seven letter codes

8. The block diagram represents which machine?



- a. Dental machine
 - b. Otoscope
 - c. Suction machine
 - d. Colonoscope
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9. This device or machine helps us to examine the media and the posterior segment of the eye:
 - a. Otoscope
 - b. Proctoscope
 - c. Ophthalmoscope
 - d. Sigmoidoscope

 10. The test instrument that allows us to see voltage in a circuit as a function of time triggering on a particular point of the waveform so that a stationary display results is:
 - a. The Voltmeter
 - b. The Oscilloscope
 - c. The Stabilizer
 - d. The Function Generator

11. Which of the following programmable logic device is nonvolatile
- PROM
 - EPROM
 - ROM
 - All of the above
12. _____ can be used to eliminate interference from nearby radio and television station (550KHz – 800MHz)
- Low-pass filters
 - High-pass filters
 - Inductors
 - Power supply filtering
13. 7812 is a three terminal regulator. What does the number 12 mean?
- Sequence of IC
 - 12 V
 - Property of IC
 - +12 V
14. If you have a transformer of 10:2 turns ratio with the input voltage of 120 volts. What is the output voltage?
- 20V
 - 5V
 - 12V
 - 24V
15. A table top Ultrasound machine of 2KW needs a voltage stabilizer of ($\cos \theta = 0.8$) :
- 2.5 KVA
 - 1.6 KVA
 - 2 KVA
 - 1 KVA
16. A equipment having the  IEC symbol denotes:
- Type BF equipment
 - Type B Equipment
 - Type CF equipment
 - Type B with defibrillator protection

17. _____ is current that flows from the mains part of an item of equipment through or across the insulation into the protective earth conductor.
- Enclosure leakage current
 - Patient leakage current
 - Earth leakage current
 - Patient auxiliary current
18. If we don't know our equipment stock, any allocation of resources is:
- For replacement
 - Calculated
 - Fine
 - Guesswork
19. What do we want equipment for?
- Diagnosis
 - Monitoring
 - Treatment
 - All of the above
20. Equipment used in the management of cancer is:
- Dialysis machine
 - Radiotherapy equipment
 - MRI and CT
 - X-ray machine
21. In a Pulse oximeter, _____ is used to determine the level of arterial oxygen saturation.
- Infrared light
 - X-ray
 - Laser
 - None of the above
22. In an ECG, a standard lead II, the electrodes are placed on:
- Right and left arm
 - Right arm and left leg
 - Left arm and left leg
 - Right leg

23. Interfering voltage in the ECG will have a frequency of:
- 30 Hz
 - 40 Hz
 - 50 Hz
 - 60 Hz
24. Total lung capacity equals to:
- Vital capacity + Residual volume
 - Inspiratory capacity + Functional Residual capacity
 - Vital capacity + Inspiratory capacity
 - Inspiratory capacity + Residual volume
25. _____ is an instrument which isolates monochromatic radiation in a more efficient and versatile manner than colour filters used in filter photometers.
- Colorimeters
 - Spectrophotometers
 - Photometers
 - Monochromators
26. The instrument that carries out a continuous and simultaneous recording of the instantaneous foetal heart rate and labour activity is called:
- Cardiotocograph (CTG)
 - Electro-oculograph ((EOG)
 - Electroretinograph (ERG)
 - Ballistocardiograph (BCG)
27. What is the pressure used for suction in the neonates:
- 50 mmHg
 - 100 mmHg
 - 200 mmHg
 - 600 mmHg
28. The wall of the X-ray room made of bricks should have a thickness of:
- 13 cm
 - 15 cm
 - 23 cm
 - 31 cm

29. If the temperature probe attached to the baby in the incubator while in operation comes out of the incubator, the condition in the incubator will be:
- Incubator will shut down automatically
 - Will function normally
 - The temperature inside the incubator will keep on falling
 - The temperature inside the incubator will keep on rising
30. Phototherapy involves exposure of the skin of the jaundiced baby to visible blue light of wavelength _____ nm generated by artificial light sources.
- 280 – 400
 - 400 – 520
 - 520 – 640
 - 640 - 760

PART – II : Short Answer Questions (20 marks)

Answer ALL the questions. Each question carries 5 marks.

- The number of Medical equipments being disposed is on the rise and contributes to e-waste. You as a Biomedical Engineer, how would you handle e-waste generated from our health centers? What recommendation would you give to the government to reduce e-waste?
- Mention ten reasons why Medical equipment may be out of order? What are the major issues arising when importing technology?
- What is Emotional Intelligence (EI or EQ)? How do you think, EI and with its attributes help or emulate yours and others attitude in your work place? Why do you think emotional intelligence is so important?
- Infusion pumps, rather than depending on gravity to generate flow develop pressure by one of several electro-mechanical means. Describe the two methods used? What are the two main components of drug infusion system?

SECTION B

Case Study

Choose either Case 1 or Case 2 from this Section. Each Case carries 50 marks.

CASE 1

The Department of Medical Services, MoH is organizing a workshop training program for the Intensive care unit health workers, Operation theatre health works and Biomedical engineers and technicians on Ventilators. You as a Biomedical engineer has been asked to prepare and present the training material on ventilator. Explain and detail out the following:

- a. Types of Ventilator
- b. Classification of ventilator based on the source of power
- c. Explain the following:
 - i. Lung compliance
 - ii. Airway resistance
 - iii. Tidal volume
 - iv. Minute volume
 - v. Respiration rate
 - vi. Conventional Mechanical Ventilation (CMV)
 - vii. Intermittent Mandatory Ventilation (IMV)
 - viii. Synchronized Intermittent Mandatory Ventilation (SIMV)
 - ix. Patient circuit
 - x. Mandatory Minutes Volume Ventilation (MMV)
 - xi. Positive End Expiratory Pressure (PEEP).
- d. Apart from ventilation, humidification of the breathing gas plays a leading role in the intensive care of patients. Explain why humidifiers, nebulizers and aspirators are important

- e. Draw a standard two bedded ICU unit block diagram with all the relevant medical equipment required as may be placed in an adult ICU (you may draw the equipment and others in text box form)

CASE 2

The Ministry of Health is about to complete a 40 bedded district hospital at Samtse Dzongkhag. You as a Biomedical engineer have been asked to submit a detailed medical equipment infrastructure required for the hospital. The proposal needs to be detailed as follows.

- a. Identify and mention the total list of medical equipment for respective clinical, therapeutic and maintenance departments.
- b. Recommend to the project manager to incorporate various protective and safety measures to protect this medical equipment from nature and manmade.
- c. Detail out a comprehensive monitoring and a maintenance plan for these equipment for the next five years.
- d. Structure and detail out a comprehensive training program for the users of the medical equipment and to biomedical engineering people for operation and maintenance of the equipment.
- e. With immense accumulated knowledge gained in the field of Biomedical engineering, with the dream to join the civil service and dedicate yourself in the service of the people of Bhutan.
 - i. How do you intend to contribute and emulate the current running services as being rendered from Biomedical Engineering Division?
 - ii. What in your opinion needs to be addressed or changed and why?
 - iii. With Bhutan's current technological advancement in this field, in your opinion, what steps or measures do you feel should the government take to address the sustainability of free healthcare in terms of medical equipment infrastructure?