MAHARASHTRASTATE BOARD OF TECHNICAL EDUCATION
(Autonomous)
(ISO/IEC - 27001 - 2005 Certified)

SUMMER– 2017 EXAMINATION

17210

Model Answer **Subject Code:**

Important Instructions to examiners:

1) *The answers should be examined by key words and not as word-to-word as given in the model answer scheme.*
2) *The model answer and the answer written by candidate may vary but the examiner may try to assess the understanding level of the candidate.*
3) *The language errors such as grammatical, spelling errors should not be given more Importance (Not applicable for subject English and Communication Skills.*
4) *While assessing figures, examiner may give credit for principal components indicated in the figure. The figures drawn by candidate and model answer may vary. The examiner may give credit for any equivalent figure drawn.*
5) *Credits may be given step wise for numerical problems. In some cases, the assumed constant values may vary and there may be some difference in the candidate's answers and model answer.*
6) *In case of some questions credit may be given by judgment on part of examiner of relevant answer based on candidate's understanding.*
7) *For programming language papers, credit may be given to any other program based on equivalent concept.*
8) ***Note: - In few Question Papers of 17210 in Q1-j, Q2-a and Q3-d Exponential Sign is Not Clearly Visible, If student attempted to solve the Questions as on actual data then consider accordingly.***

Q. No.	Sub Q.N.	Answer	Marking Scheme
1.		**Attempt any <u>NINE</u> of the Following:**	**18**
	a)	**State Ohm's law. Give meaning of the symbols used.**	**2**
		Statement	1
		Symbol meaning	1
		Ohm's law: If physical state of the conductor remains same, then the electric current flowing through the conductor is directly proportional to the potential difference across it. $V = IR$ Where, V= Potential difference, I = Current, R = Resistance	
	b)	**State the principle of potentiometer device.**	**2**
		The fall of potential is directly proportional to the length of conducting wire. $V \propto L$ OR The potential difference between two points of conductive wire is directly proportional to the length/distance between the two points.	

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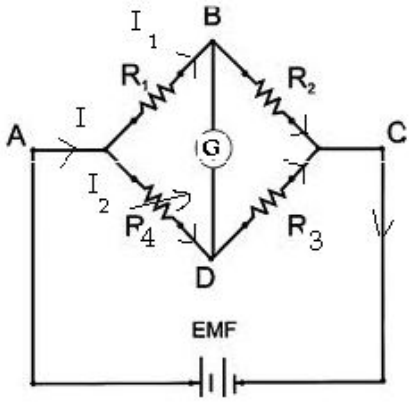
Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	c)	**Draw a neat diagram of Wheatstone's network.** **Diagram.**  	**2** 2
	d)	**Write the factors on which capacity of parallel plate condenser depends.** **Each factor** **Factors on which capacity of parallel plate condenser depends :** A = Area of each plate d= Distance between two plate k = Dielectric constant of the medium ε_0 = Permittivity of free space	**2** 1/2
	e)	**Define one Farad.** **One Farad :** Is the capacitance of the capacitor which requires a charge of one coulomb to establish potential difference of one volt between its plates. **OR** If one coulomb of charge is required to increase the potential of a condenser by 1 volt, then the capacity is one farad.	**2**
	f)	**Draw a neat labelled diagram showing capacitors connected in parallel combination.** **Labelled diagram**	**2** 2

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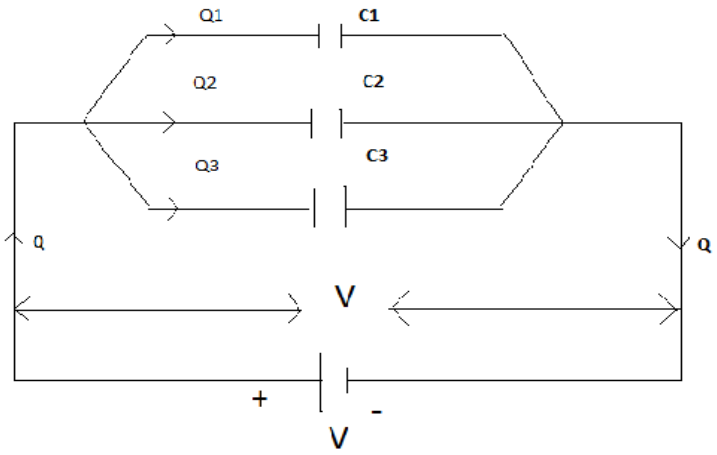
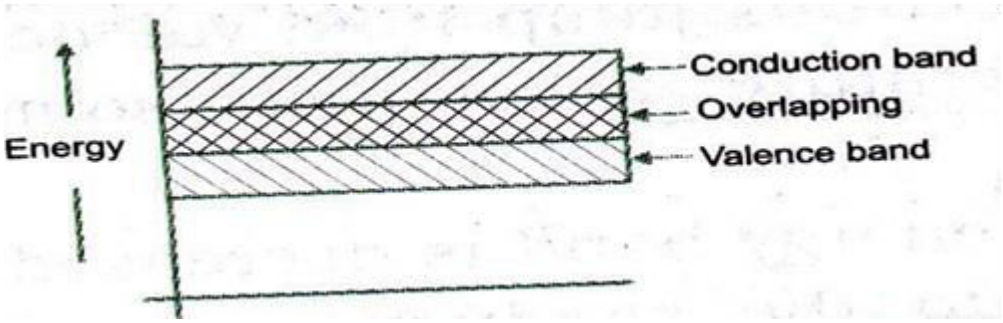
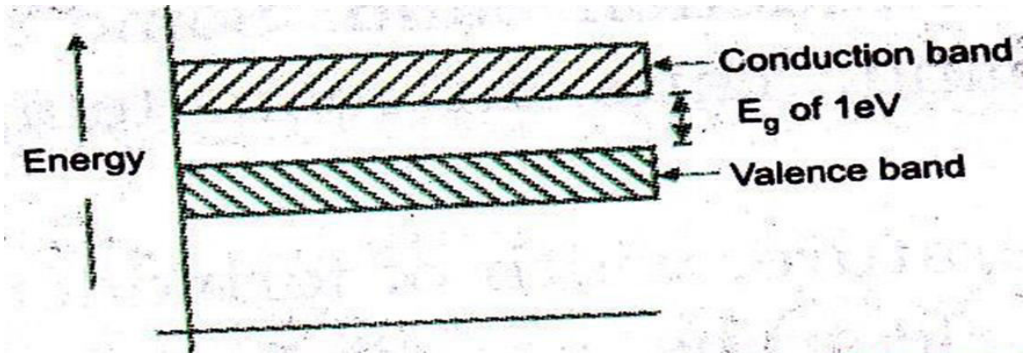
Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	f)		
	g)	**Draw energy band diagram for conductors and semiconductors.** **Each Band diagram** **Conductor:**  **Semiconductor:** 	**2** 1

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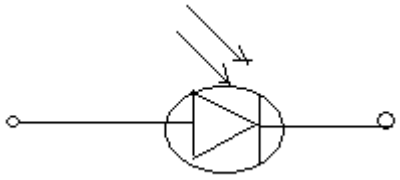
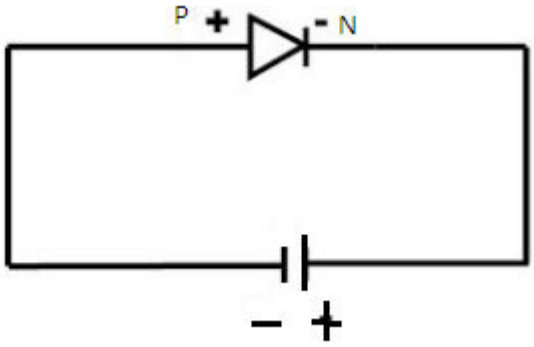
Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	h)	**State the principle of photodiode and draw its symbol.** **Principle** **Symbol** **Principle of the photodiode**: When light is incident on suitably arranged semiconductor diode, then it produces current in the circuit. Light energy → Electrical energy **Symbol** 	**2** 1 1
	i)	**Draw the circuit diagram of reverse biased PN junction diode.** **Diagram with label** 	**2** 2
	j)	**An accelerated electron emits a quantum of radiation with frequency $8x10^8$ Hz. Calculate the energy of electron. Given h= $6.62x10^{-34}$Js.** **Formula.** **Answer with unit.** **Given h= $6.62x10^{-34}$Js , ν= $8x10^8$ Hz . To find : E= ?** $E = h\nu = 6.62x10^{-34} x\ 8x10^8$ **$E = 5.296\ X10^{-25}$ J**	**2** 1 1

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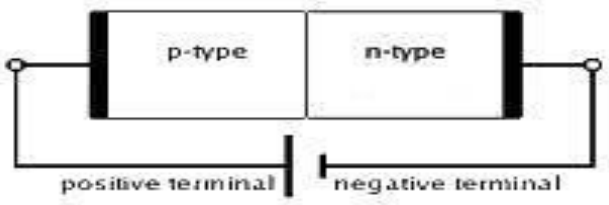
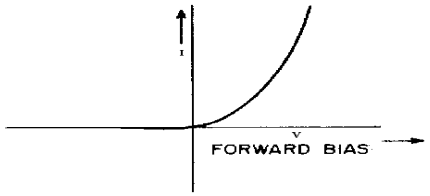
Q. No.	Sub Q.N.	Answer	Marking Scheme
1.	k)	**Give full form of LASER .**	**2**
		Full form	2
		Light Amplification by Stimulated Emission of Radiation.	
	l)	**Name zero dimensional and one dimensional nano material.**	**2**
		Each example	1
		Nano material of zero dimension	
		Nanoclusters	
		Nano material of one dimension-	
		Carbon nanotube, nanofiber etc**.**	
2.		**Attempt any FOUR of the following.**	**16**
	a)	**The specific resistance of the material of a wire is 2.81 x10^{-7} Ωm. If the resistance of the wire is 2.1 Ω and its radius is 0.8 mm, calculate the length of the wire.**	**4**
		Formula with substitution	2
		Answer with unit	2
		Given: ρ = 2.81 x10^{-7} Ωm , R = 2.1 Ω , r =0.8 mm = 0.8 x 10^{-3} m	
		To Find: L=?	
		$R = \rho L / A = \rho L / \pi r^2$	
		L = Rπr^2/ ρ = 2.1 x3.14 x $(0.8 \times 10^{-3})^2$ / 2.81 x10^{-7} = 15.07 m.	
	b)	i) **State the principle of potentiometer.**	**4**
		ii) **Define potential gradient.**	
		Principle	2
		The fall of potential is directly proportional to the length of conducting wire.	
		$V \propto L$ OR	
		The potential difference between two points of conductive wire is directly proportional to the length/distance between the two points.	
		ii) Definition	2
		Potential gradient is defined as the fall of potential per unit length of potentiometer wire.	
		OR	
		P.G. = Potential / Length	

Q. No.	Sub Q.N.	Answer	Marking Scheme
2.	c)	**Find the area of parallel – plate condenser if its capacitance is 3μF, distance between the two plates is 0.04 mm, dielectric constant is 6 and $\varepsilon_0 = 8.9 \times 10^{-12}$ SI unit.**	**4**
		Formula with substitution	2
		Answer with unit	2
		Given: C= 3μF = 3 x 10^{-6} F , d = 0.04 mm = 0.04 x 10^{-3} m , K=6, ε_0 = 8.9 x 10^{-12} SI unit **. To Find : A= ?**	
		C= $\varepsilon_0 KA/d$, A = **Cd /** $\varepsilon_0 K$ = 3 x 10^{-6} x 0.04 x 10^{-3} / 8.9 x 10^{-12} x 6 = 2.25 m^2.	
	d)	**Explain forward biased PN junction diode. Draw its I-V characteristics.**	**4**
		Each diagram	1
		Explanation	2
			
		Explanation: Above circuit diagram shows PN junction diode in forward bias mode. In forward bias mode P-type of semiconductor is connected to positive terminal and N-type of semiconductor is connected to negative terminal of battery. Holes in the p-region get repelled by positive terminal of battery and cross the junction. . Also electrons in the n-region get repelled by negative terminal of battery and cross the junction. When the voltage applied across PN junction reaches to 0.7V (Si) the current flows through the diode i.e. the diode start conducting current. Following graph shows current voltage characteristics of PN junction forward bias.	
		 *Voltage-current characteristic for a p-n junction.*	

Q. No.	Sub Q.N.	Answer	Marking Scheme
2.	e)	**Differentiate between N-type and P- type semiconductor** **Any four points**	**4** 4

Sr. No	**N- type Semiconductor**	**P- type Semiconductor**
1	When small amount of pentavalent impurity is added to a pure semiconductor is called N-type semiconductor	When small amount of trivalent impurity is added to a pure semiconductor is called P-type semiconductor
2	Impurity is used for doping is arsenic, anatomy, phosphorus	Impurity is used for doping is gallium, indium, boron, aluminium
3	It is called donor impurity	It is called acceptor impurity
4	There are excess of electrons	There are shortage of electrons
5	The electrons are majority carriers	The holes are majority carriers

	f)	**State four applications of LDR.** **Each application** i) In camera for exposure control ii) In photocopy machine iii) In security alarms iv) As smoke detector v) In street light control **Any other relevant application may consider.**	**4** 1

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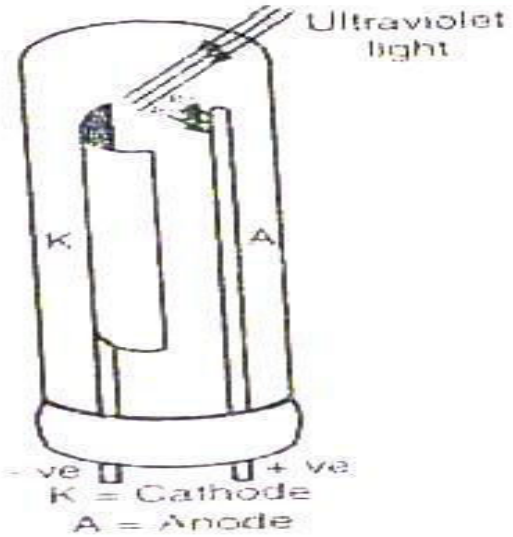
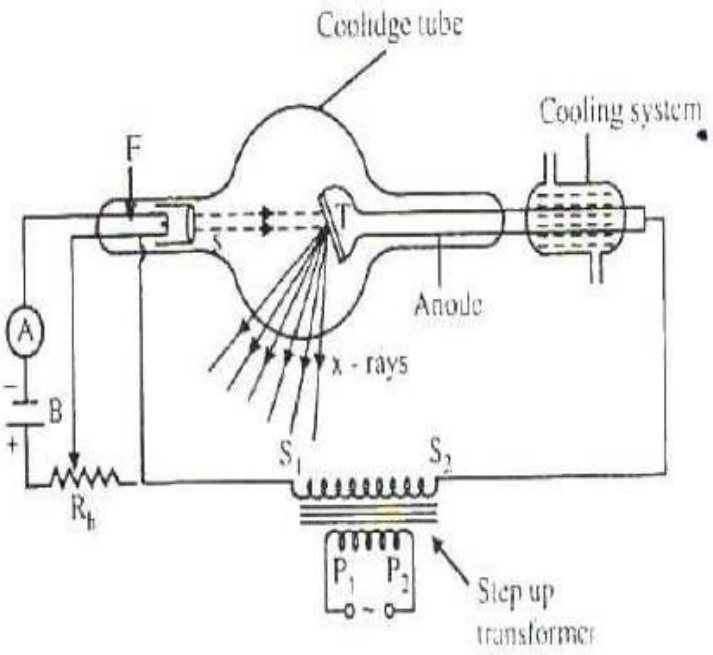
Q. No.	Sub Q.N.	Answer	Marking Scheme
3		**Attempt any FOUR of the following:**	**16**
	a)	**Draw a neat labelled diagram of photocell and state two properties of photons.**	**4**
		Diagram.	2
		Any two properties.	2
		Photocell: 	
		Properties of Photon: 1) Photon is electrically neutral. 2) Photon travels with speed of light. 3) Photon do not ionized. 4) Photon has rest mass zero. 5) Photon cannot be deflected by electric or magnetic field. 6) Photon has momentum term h / λ 7) Photon has definite packets of energy given by E = hυ	
	b)	**Explain the production of X-ray's using Coolidge tube.**	
		Diagram.	**4**
		Principle	1½
		Explanation of Production.	1 1½

Q. No.	Sub Q.N.	Answer	Marking Scheme
3	b)	 T – Target F – Metal filament S – Cylinder A – Ammeter B – Battery R_h – Rheostat P_1 P_2 – Primary of transformer S_1, S_2 – Seconday of transformer **Principle:** When fast moving electrons are suddenly stopped then X- rays are produced. **Production:** 1. When the cathode is heated by electric current it produced electron due to thermionic emissions. 2. The beam of electron is then focused on the anode (target). 3. The electrons from cathode are accelerated by applying of high voltage between cathode & anode using step up transformer. 4. When these fast moving electrons are suddenly stopped by tungsten anode, they lose their kinetic energy and x rays are produced from the target. Some amount of Kinetic energy is Converted to large amount of heat. 5. By controlling the filament current, the thermionic emission of electron hence intensity of X- rays can be controlled. 6. The X-rays of high penetrating power and higher frequency are called hard X-rays and those with low frequency are called soft X-rays. 7. The intensity of X-ray depends on filament current, penetrating power of X-ray depends on P.D. between cathode and anode.	

Q. No.	Sub Q.N.	Answer	Marking Scheme
3	c)	**State four applications of X-ray's.** **Each application.** **Application of X-rays:** i)X- rays are used to detect the cracks in the body of aero plane ii) X- rays are used to detect the manufacturing defects in rubber tyres or tennis ball in quality control. iii) X – rays are used to detect flows or cracks in metal jobs iv) X- rays are used to distinguish real diamond from duplicate one. v) X- rays are used to detect smuggling gold at airport and docks (ship) yard. vi) X-rays are used to detect cracks in the wall. vii) X- ray radiography is used to check the quality of welded joints. **Any other relevant application may consider.**	**4** 1
	d)	**Calculate the minimum wavelength and maximum frequency of X-ray's produced by an X-ray tube working at 40 kV.** **Given: h= 6.62 x 10^{-34} Js, c = 3 x 10^{8} m/s, e = 1.6 x 10^{-19} C** **Formula and substitution.** **Answer with unit.** Given: V = 40 kV = 40 x 10^{3} V We have, $\lambda = h c / eV$ $\lambda = 6.62 \times 10^{-34} \times 3 \times 10^{8} / 1.6 \times 10^{-19} \times 40 \times 10^{3}$ $\lambda = 0.3103 \times 10^{-10}$ m **$\lambda = 0.3103\ A^{0}$** Now, $\upsilon = c / \lambda$ $\upsilon = 3 \times 10^{8} / 0.3103 \times 10^{-10}$ **$\upsilon = 9.66 \times 10^{18}$ Hz**	**4** 2 2

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Q. No.	Sub Q.N.	Answer	Marking Scheme
3	(e)	**State the engineering applications of LASER.** **Any four applications** i) Lasers are used for engraving and embossing of printing plates For example- number plate, name plate etc., ii) Lasers are used in cutting, drilling and welding metals. iii) Lasers are used in holography iv) Lasers are used in computer printers v) Lasers are used for 3D, Laser scanners vi) Lasers are used in controlled heat treatment vii) Lasers are used for data transfer through optical fiber from one computer to other viii) Lasers are used to find flaws or defect in material.	**4** 4
	(f)	**State four application of nano material in engineering field.** **Each application.** **Applications of nonmaterial in engineering field.** 1. **Data storage system –** Semiconductor material in the form of film can be deposited on substrate to form the chip. 2. **Use of nanomaterial in energy sector** – The conventional energy sources like coal, fuel are depleting day by day, thus use of alternative energy source is inevitable. 3. **Application in automobiles-** High mechanical strength material but light in weight can be produced by using nanotechnology. Nano painting materials can be used to get uniform layer of coating on the vehicle body. 4. Small motors required for cd-players and wiper movement made by nanotechnology will reduce size and weight hence the power consumption. **Note: Any other relevant application.**	**4** 1