Name: **Enrolment No:** R110217145	

Course: MATH 1002 – Mathematics I

Programme: B.Tech. (All SoCSE Branches)
Semester: I (ODD-2017-18)
Time: 02 hrs. **Max. Marks:100**

Instructions:
Attempt all questions from **Section A** (each carrying 4 marks); attempt all questions from **Section B** (each carrying 10 marks); attempt all questions from **Section C** (each carrying 20 marks).

Section A
(Attempt all questions)

1.	If $V = \frac{x^3y^3}{x^3+y^3}$, prove that $x\frac{\partial V}{\partial x} + y\frac{\partial V}{\partial y} = 3V$.	[4]	CO1
2.	Evaluate $\iint_R y\,dx\,dy$, where R is the region bounded by the parabolas $y^2 = 4x$ and $x^2 = 4y$.	[4]	CO1
3.	Find the n^{th} derivative of $\frac{1}{1-5x+6x^2}$.	[4]	CO1
4.	If p be "He is rich" and q be "He is Generous". Write in simple sentences the meaning of the following: $(i) \sim p$ (ii) $\sim (p \vee q)$ (iii) $p \rightarrow q$ (iv) $\sim p \wedge \sim q$	[4]	CO2
5.	Use truth table to show that $p \rightarrow q \equiv \sim p \vee q$	[4]	CO2

SECTION B
(Q6-Q8 are compulsory and Q9 has internal choice)

6.	If $\cos^{-1}\left(\frac{y}{b}\right) = \log\left(\frac{x}{m}\right)^m$, then prove that $x^2y_{n+2} + (2n+1)xy_{n+1} + (n^2+m^2)y_n = 0$	[10]	CO1
7.	Find the volume bounded by the cylinder $x^2 + y^2 = 4$ and the planes $y + z = 4$ and $z = 0$	[10]	CO1
8.	If $u^3 + v^3 + w^3 = x + y + z$, $u^2 + v^2 + w^2 = x^3 + y^3 + z^3$, $u + v + w = x^2 + y^2 + z^2$, then show that $\frac{\partial(u,v,w)}{\partial(x,y,z)} = \frac{(x-y)(y-z)(z-x)}{(u-v)(v-w)(w-u)}$.	[10]	CO1

9.	Using the truth table, obtain the principal disjunctive normal form of the following: (i) $p \wedge (p \rightarrow q)$ (ii) $q \vee (p \vee \sim q)$ **OR** Show that the following statement is a tautology using truth table $((p \vee q) \wedge (p \rightarrow r) \wedge (q \rightarrow r)) \rightarrow r$	[10]	CO2
	SECTION C **(Q10 is compulsory and Q11A, Q11B have internal choice)**		
10.A	A rectangular box, open at the top, is to have a volume of 32 cc. Find the dimensions of the box requiring the least material for its construction.	[10]	CO1
10.B	Use truth table to prove the distributive law $p \vee (q \wedge r) \equiv (p \vee q) \wedge (p \vee r)$	[10]	CO2
11.A	Change the order of integration in $I = \int_0^1 \int_{x^2}^{2-x} xy \; dy \; dx$ and hence evaluate the same. **OR** Evaluate $\int_0^1 \int_0^{\sqrt{1-x^2}} \int_0^{\sqrt{1-x^2-y^2}} \frac{dz\, dy\, dx}{\sqrt{1-x^2-y^2-z^2}}$	[10]	CO1
11.B	Transform to Cartesian coordinates and hence evaluate $\int_0^{\pi} \int_0^{a} r^3 \sin\theta \cos\theta \, dr d\theta$ **OR** Evaluate $\iint_R [x+y] \, dx \, dy$ over the rectangle $R = [0,\ 1;\ 0,2]$ where $[x+y]$ denotes greatest integer less than or equal to $(x+y)$.	[10]	CO1

Roll No: 110217195

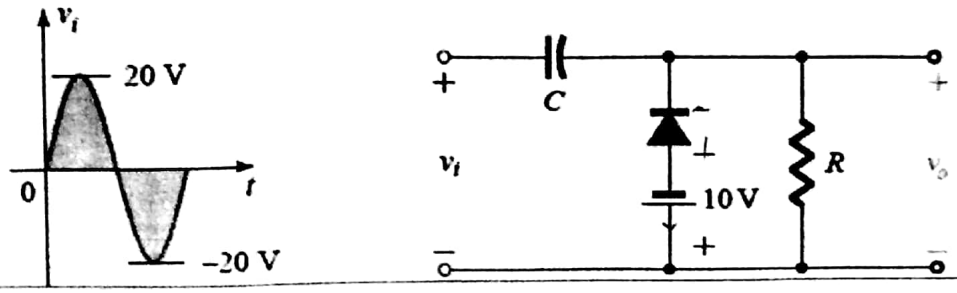
UNIVERSITY OF PETROLEUM & ENERGY STUDIES

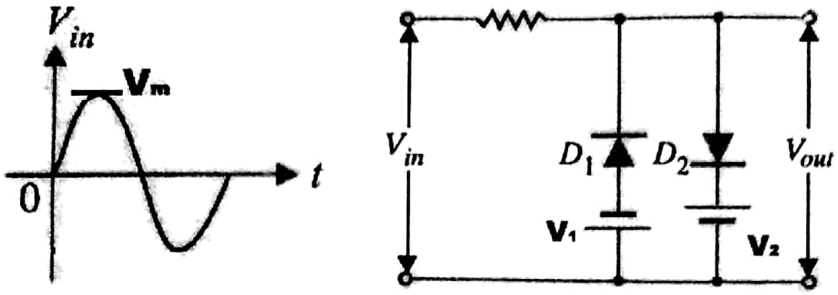
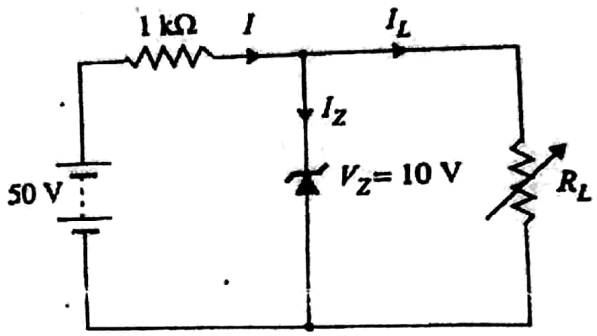
Mid-Term Examination – October, 2017

Program/Course : B.Tech (CIT: CCVT, GG, MFT, MC, OSS, SCF, IOT, OG, CYBER LAW, BIG DATA, DevOps) — **Semester : I**
Subject: Basic Electronics Engineering — **Max. Marks : 100**
Code : PHYS1003 — **Duration : 2 Hrs**
No. of page/s: 02

Instructions:

1. **Draw suitable circuit diagrams wherever required to justify your answer.**
2. **Your answer should be concise and to the point.**

	Section A (All questions are compulsory)		
1.	Write a brief note on charge neutrality equation in semiconductors.	**[4]**	**CO1**
2.	Briefly explain the effect of biasing on the width of depletion layer of PN junction diode.	**[4]**	**CO1**
3.	A silicon p-n junction diode having internal forward resistance $R_f = 20\Omega$ is used for half-wave rectification. If the applied input voltage is $V = sin\omega t$ and load resistance $R_L = 2000\Omega$, find the d.c. output current (I_{dc}) and the effective output current (I_{rms}).	**[4]**	**CO2**
4.	Draw the energy band diagram of intrinsic and extrinsic semiconductor with fermi level.	**[4]**	**CO1**
5.	Calculate the base current if direct current gain (α) in common base circuit of transistor is 0.96 and emitter current is 2 mA.	**[4]**	**CO3**
	Section B (All questions are compulsory. Question no. 9 has internal choice)		
6.	What is a rectifier? Discuss the working of a full wave bridge rectifier and mention its advantages over center tapped full wave rectifiers.	**[10]**	**CO2**
7.	a) The diode current is 0.5 mA at 340 mV and 15 mA at 440 mV. Determine the value of η (ideality factor) assuming kT/q = 25 mV. b) Find the intrinsic carrier concentration of Germanium if its intrinsic resistivity at 300K is 0.47Ω.m. It is given that the electronic charge is 1.6×10^{-19} Coulomb and the electron and hole mobilities at 300K are 0.39 and 0.19 m^2/volt.sec respectively.	**[5+5]**	**CO1**
8.	Discuss the action of a n-p-n transistor as in common-emitter configuration with the help of a circuit diagram. Also draw the input and output characteristics and derive a relation between the two current gains.	**[10]**	**CO3**
9.	Solve the given clamper network to draw its output waveform. 	**[10]**	**CO2**

	OR Solve the given clipper circuit consisting to draw its output waveform assuming diode terminal voltage as V_T. 		
	Section C (Question 10 is compulsory. Question 11 has internal choices.)		
10.	a) For the given circuit, determine the range of load resistance R_L that will result in a constant voltage of 10 V across R_L. Given I_{ZM} = 32 mA 	**[10]**	**CO2**
	b) What is a filter circuit? Explain the working of L-section and π-section filter circuit long with the suitable circuit diagram.	**[10]**	**CO2**
11. (a)	A sample of intrinsic silicon has electron and hole mobilities as 0.13 and 0.05 $m^2/V\text{-}s$ respectively at 300K. If the density of electrons and holes are each equal to 1.5×10^{16} m^{-3} at 300K find the electrical conductivity for addition of 1 donor impurity atom in 10^9 silicon atoms. Given that the density of Si atoms is 5.0×10^{22} cm^{-3}.	**[10]**	**CO1**
	OR		
	Differentiate between Avalanche and Zener breakdown in p-n junction diode. Discuss the effect of temperature on Avalanche and Zener breakdown voltages.	**[10]**	**CO1**
11. (b)	Explain the construction and working of Junction Field Effect Transistor (JFET) with the help of suitable diagram.	**[10]**	**CO3**
	OR		
	Discuss the construction and working of depletion type Metal Oxide Semiconductor Field Effect Transistor (D-MOSFET) with the help of suitable diagram.	**[10]**	**CO3**

Roll No: 11021714S

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
Mid Semester Examination, ~~March~~ OCTOBER, 2017

Program Name: B. Tech- CS **Semester – I**
Course Name : CCVT, OGI, Big Data, OSS **Max. Marks : 100**
Course Code : PHYS 1002 **Duration : 2 Hrs**
No. of page/s: 2

Instructions:
All questions are compulsory.
Question numbers to be written very clearly.

SECTION A (All parts are compulsory)

1.	Discuss essential features for lasing action	[4]	CO1
2.	Differentiate between ordinary photography and holography.	[4]	CO1
3.	The numerical aperture of a fiber is 0.25 and relative refractive index is 0.02. Determine the refractive indices of the core and cladding of a fiber.	[4]	CO1
4.	Find the divergence of vector $\vec{A} = \rho^3 \sin\varphi\, \hat{a}_\rho + \rho^2 z\, \hat{a}_\varphi + \rho z^2 \cos\varphi\, \hat{a}_z$ in cylindrical coordinates.	[4]	CO2
5.	Write four Maxwell's equations in differential and integral form for static fields.	[4]	CO3

SECTION B (Question 9 has internal choice)

6 (a)	In holography, explain the process of reconstruction of image.	[5]	CO1
6 (b)	Given the potential $V = \frac{10}{r^2} \sin\theta \cos\varphi$, find the electric flux density $\vec{D}$ at (2, π/2, 0).	[5]	CO2
7.	In a certain region, $\vec{J} = 3r^2 \cos\theta\, \hat{a}_r - r^2 \sin\theta \hat{a}_\theta$ A/m, find the current crossing the surface defined by $\theta = 30°$, $0 < \phi < 2\pi$, $0 < r < 2$ m.	[10]	CO2
8 (a)	Explain Biot Savart's law showing magnetic field intensity generated by an electric current and show the direction of field with a suitable diagram.	[5]	CO3
8(b)	Given the magnetic flux density $\vec{B} = \frac{\rho}{2}\hat{a}_\phi$ Wb/m, calculate the total magnetic flux crossing the surface $\varphi = \frac{\pi}{2}$, $1 < \rho < 3$ meters and $0 < z < 3$ meters.	[5]	CO3
9 (a)	Discuss five differences between Ruby laser and Helium Neon Laser. **OR** Explain the working of He-Ne laser with suitable energy level diagram.	[5]	CO1
9 (b)	Differentiate between different types of optical fibers. **OR** Discuss the propagation mechanism in graded index multimode fiber.	[5]	CO1

SECTION C (Question 11 has internal choice)

10 (a)	Explain the terms absorption, spontaneous emission and stimulated emission of radiation. Obtain a relation between transition probabilities of spontaneous and stimulated Emission. Calculate the ratio of stimulated to spontaneous emission at a temperature of 300^0 C for Sodium D line.	[6+4]	CO1
10 (b)	A multimode step index fiber has a core diameter of 80 μm and relative refractive index difference of 1.5% is operating at a wave length of 0.85 μm. If the core refractive index is 1.48, calculate:- (i) The normalized frequency of the fiber. (ii) The maximum number of guided modes.	[5+5]	CO1
11 (a)	Point charges Q_1 and Q_2 are, respectively, located at (4, 0, -3) and (2, 0, 1). If $Q_2 = 4$nC, find Q_1 such that (i) The E at (5, 0, 6) has no z-component (ii) The force on a test charge at (5, 0, 6) has no x-component. **OR** Show that the expression for bound surface and volume charge densities for a polarized dielectric are $\rho_{ps} = \vec{P}.\vec{a_n}$; $\rho_{pv} = -\nabla.\vec{P}$		CO2
11(b)	State and explain Ampere's circuital law. Find the magnetic field intensity due to an infinite line current using Ampere's circuital law. **OR** Deduce the expression for displacement current density J_d. Calculate displacement current density in free space where $\vec{E} = 20\cos(\omega t - 50x)\,\hat{a}_y$ V/m.	[10]	CO3

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
Permittivity of free space (ε_o)	8.854×10^{-12} Farad/meter
Velocity of Light c	3×10^8 m/sec
Boltzmann constant (k_B)	1.38×10^{-23} J K^{-1}