(7)

[This question paper contains 5 printed pages.]

4/12/17

Your Roll No..............

Sr. No. of Question Paper : 5767 **H**

Unique Paper Code : 222301

Name of the Paper : PHHT-307 : Mathematical Physics III

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all.
3. Q. No. **1** is compulsory.
4. Attempt any **two** questions from each Section.
5. The symbols have their usual meanings.

1. Attempt any **five** questions :

(a) Find the polar form of $z = 2 + 2\sqrt{3}\, i$.

(b) Find the principal value of $(1 + i)^i$.

(c) Show that $P_n'(-1) = (-1)^{n+1}\left(\frac{n(n+1)}{2}\right)$.

(d) Find $\lim_{z \to 1+i}\left[\frac{z-1-i}{z^2-2z+2}\right]^2$.

(e) Show that $J_n(-x) = (-1)^n J_n(x)$.

(f) Find the value of the complex integral $\frac{1}{2\pi i}\oint_c \frac{e^z}{z-2i}\,dz$ where $c : |z| = 1$.

(g) Describe graphically the region $1 < |z-i| \le 2$. (3×5)

SECTION A

2. (a) Solve the equation $z^5 + 32 = 0$ and plot the roots graphically. (5)

(b) Prove the Cauchy Riemann conditions for a function to be analytic in Cartesian co-ordinates. (6)

(c) Check the analyticity of function $f(z) = \sin(2z)$. (4)

3. (a) State and Prove Residue Theorem. (4)

(b) Evaluate $\oint_C \frac{e^{2t}}{z^{2+1}}\,dz$ if $t > 0$ and $c : |z| = 3$. (4)

(c) If f(z) be analytic inside and on the boundary C of a simply connected region R abd 'a' is any point inside C, prove that $f'(a) = \frac{1}{2\pi i}\oint \frac{f(z)}{((z-a)^2}\,dz$. (7)

4. (a) Find first four terms of the Taylor's series of the function $f(z) = \ln(1+z)$ about $z = 0$. (7)

(b) Expand $f(z) = \frac{z}{(z-1)(2-z)}$ in a Laurent series valid for

(i) $|z| < 1$

(ii) $|z-1| > 1$ (8)

5. Evaluate any two of the following using contour integration (7.5,7.5)

(a) $\int_0^{2\pi} \frac{\cos 3\theta}{5-4\cos\theta}\,d\theta$

(b) $\int_0^{\infty} \frac{dx}{x^4+1} dx$

(c) $\int_0^{\infty} \frac{\cos mx}{x^2+1} dx$

SECTION B

6. (a) Locate and name the singularities of the equation

$x(x-1)y'' + (3x-1)y' + y = 0$ and

(b) Find its general solution using Frobenius method. (5,10)

7. (a) Prove that $L_{n+1}(x) = (2n+1-x)L_n(x) - n^2L_{n-1}(x)$. (8)

(b) Show that $L_n(0) = 1$. (3)

(c) Find the value of $J_{-1}(x) + J_1(x)$. (4)

8. (a) If $f(x) = \sum_{n=0}^{n=\infty} a_n P_n(x)$ for $-1 < x < 1$, then show that

$a_n = \frac{2n+1}{2} \int_{-1}^{1} f(x) P_n(x)\, dx$, hence expand

$f(x) = x^2 + 5x - 2$ in series of the form

$\sum_{n=0}^{n=\infty} a_n P_n(x)$

(Given $P_0(x) = 1$, $P_1(x) = x$, $P_2(x) = \frac{3x^2-1}{2}$). (7)

(b) Prove the orthogonality condition for Legendre's polynomial

$$\int_{-1}^{1} P_m(x) P_n(x) dx = \frac{2}{2n+1} \delta_{mn}$$ (8)

9. (a) Show that $H_{2n+1} = 0$. (4)

(b) Show that $xJ_n'(x) = -nJ_n(x) + xJ_{n-1}(x)$. (5)

(c) Prove that $J_n(x)$ is the coefficient of t^n in the expansion of

$$\exp\left(\frac{x}{2}\left(t - \frac{1}{t}\right)\right).$$ (6)

(8)

16/12/17

[This question paper contains 4 printed pages]

Your Roll No. : ....

Sl. No. of Q. Paper : **5770** **H**

Unique Paper Code : 235362

Name of the Course : **B.Sc.(Honours) Physics**

Name of the Paper : Mathematics-I/[PHHT-310]

Semester : III

Time : 3 Hours ***Maximum Marks : 75***

Instructions for Candidates :

(a) Write your Roll No. on the top immediately on receipt of this question paper.

(b) Attempt any **two** parts from each question.

(c) Each part of question carries 7.5 marks.

1. (a) Prove that the limit of a sequence if it exists is unique. Using the definition of the convergence of a sequence prove that if p>o, then

$$\lim_{n\to\infty} \frac{1}{n^p} = 0$$

P.T.O.

(b) Let (a_n) be a sequence defined as follows :

$$a_1 = 1, a_{n+1} = \frac{3+2a_n}{2+a_n};\ n \geq 1$$

Show that $<a_n>$ converges. Find $\lim_{n\to\infty} a_n$.

(c) Show that the sequence $<r^n>$ converges if and only if $-1<r\leq 1$.

2. (a) Prove that a positive term series $\sum_{n=2}^{\infty} \frac{1}{n(\log n)^p}$ converges if $p>1$.

(b) Test the convergence of the following series :

(i) $\sum_{n=1}^{\infty} \frac{2^{n-1}}{3^n+1}$

(ii) $\sum \frac{1}{\sqrt{n}+\sqrt{n+1}}$

(c) Define absolute and conditional convergence of an alternating series.

Show that the series $\sum_{n=1}^{\infty} \frac{(-1)^{n+1}}{n^p}$ is absolutely convergent if $p>1$ and conditionally convergent if $0<p\leq 1$.

3. Let R be the set of real numbers.

(a) Prove that the Dirichlet's function f defined on R by

$$f(x) = \begin{cases} 1, x \text{ is rational} \\ -1, x \text{ is irrational} \end{cases}$$

is discotinuous at every point.

(b) State and prove intermediate value theorem.

(c) Show that a function which is uniformly continuous on an interval is continuous on that interval. Show that the function $f(x)= 1/x$ is not uniformly continuous on $(0,1]$.

4. (a) Show that the function $f: R^2 \to R$ defined as

$$f(x,y) = \frac{x^3-y^3}{x^2+y^2}, (x,y) \neq (0,0) \text{ and } f(x,\ y) = 0$$

otherwise is continuous but not differentiable at origin.

(b) Expand the function $f(x,y) = x^2y+3y-2$ in powers of $(x-1)$ and $(y+2)$.

(c) State the Schwarz's theorem. Show that for the function :

$$f(x,y)=\begin{cases}\dfrac{x^2y^2}{\left(x^2+y^2\right)}, & \text{if } (x,y)\neq(0,0)\\ 0, & \text{if } (x,y)=(0,0)\end{cases}$$

$f_{xy}(0,0) = f_{yx}(0,0)$, even though the conditions of Schwarz's theorem is not satisfied.

5. (a) Using Reimann integration, show that $\int_1^2 f\,dx \frac{11}{2}$, where $f(x) = 3x + 1$.

(b) Show that if f is bounded and integrable on [a,b], then |f| is also bounded and integrable on [a,b]. Also, show that

$$\left|\int_a^b f(x)\,dx\right| \leq \int_a^b |f|(x)\,dx.$$

(c) Show that if a function f is monotonic on [a,b], then it is integrable on [a,b].

Sl-No 5794 9 4/12/17

Set A

Unique Paper Code : 2221301

Name of the Paper : Mathematical Physics II

Name of the Course : ~~Erstwhile FYUP~~ B.Sc (Hons) Physics

F-9

Semester : III

Duration : 3 Hours

Maximum Marks : 75

Instructions for Candidates

1. Attempt five questions in all.
2. Question No 1 is compulsory.

1. Attempt any **five** of the following: (5x3=15)

(a) Find the smallest period of the function $f(x) = a\cos 2\pi x + b\sin \pi x$.

(b) Show that $\int_{-L}^{L} \sin\frac{m\pi x}{l}\, cos\frac{n\pi x}{l}\, dx = 0$ for all m and n.

(c) Prove that $P_n(1) = 1$.

(d) Use Rodrigue's formula to determine the value of $P_2(x)$

(e) Evaluate: $\int_0^1 \frac{dx}{\sqrt{-\ln x}}$

(f) Prove that $J_n''(x) = \frac{1}{4}[J_{n-2}(x) - 2J_n(x) + J_{n+2}(x)]$.

(g) Verify that $u(x,y) = 4e^{(3y-2x)/2}$ is a solution to $3\frac{\partial u}{\partial x} + 2\frac{\partial u}{\partial y} = 0$.

2. Find the Fourier series expansion for the function $f(x) = x + x^2$, in the interval $-\pi < x < \pi$.
Hence deduce that: $\sum_{n=1}^{\infty} \frac{1}{n^2} = \pi^2/6$. (15)

3. (a) Show that an even function can have no sine terms in its Fourier expansion. (8)

(b) Prove that $P'_{n+1}(x) - P'_{n-1}(x) = (2n+1)P_n(x)$ (7)

(c) Evaluate the integral: $\int_{-1}^{1} P_2(x)\,[P_3(x) - 5P_2(x)]\,dx$ (3)

4.(a) Using generating function of Bessel's function prove that:

(i) $\cos(x\sin\theta) = J_0(x) + 2J_2(x)\cos 2\theta + 2J_4(x)\cos 4\theta + \cdots$

(ii) $\sin(x\sin\theta) = 2J_1(x)\sin\theta + 2J_3(x)\sin 3\theta + 2J_5(x)\sin 5\theta + \cdots$

(10)

(b) Show that $J_{\frac{3}{2}}(x) = \sqrt{\frac{2}{\pi x}}\left(\frac{1}{x}\sin x - \cos x\right)$ (5)

5. (a) Identify the singular points and their nature for the differential equation:
$(1 + x^2)y'' + xy' - (x - 1)y = 0$ (3)

(b) Solve by Frobenious method:
$x(x - 1)y'' + (3x - 1)y' + y = 0$ (12)

6. (a) Solve the boundary value problem:

$$\frac{\partial^2 y}{\partial t^2} = 4\frac{\partial^2 y}{\partial x^2}.$$

where $y(0,t) = y(5,t) = 0$; $\frac{\partial y}{\partial t}(x,0) = 0$; $y(x,0) = 5\sin \pi x$ (10)

(c) Prove that $\beta(m,n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}$; $m,n > 0$ (5)

7. Solve Laplace's equation in spherical co-ordinates:

$$\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial V}{\partial r}\right) + \frac{1}{r^2\sin\theta}\frac{\partial}{\partial\theta}\left(\sin\theta\frac{\partial V}{\partial\theta}\right) = 0,$$ assuming the boundary conditions:

$$V(1,\theta) = \begin{cases} V_0 & 0 < \theta < \pi/2 \\ 0 & \frac{\pi}{2} < \theta < \pi \end{cases}$$

(15)

S. No. 029P:5995 (10) 9/12/17 SET-A

Unique Paper Code : 2221302 B.Sc (Hons.) Physics
Name of course : ~~Erstwhile FYUP~~
Name of the paper : **Digital System and Applications**
Semester : **III-~~Semester~~**

F-9

Duration : 3 hrs. Maximum Marks : 75

(Write your roll no. on the top immediately on receipt of the question paper)
Attempt any five questions in all. Question No. 1 is compulsory.
All questions carry equal marks

Q1 Attempt any five questions of the following 5 x 3=15

(a) What are active and passive components? Give one example of each.

(b) How are ICs classified on the basis of number of components?

(c) How will you design AND gate using NOR gate?

(d) What is meant by the term edge clocked / triggered and draw a digital symbol of a negative edge triggered D flip flop.

(e) Define MOD of a counter. Draw the logic diagram of MOD-5 counter?

(f) What is a Half-Adder in digital electronics? Draw its circuit using NAND gates.

(g) What are the advantages of D flip flop over the SR flip flop?

(h) What are registers? Give the full form and use of A, PC, SP.

Q2 (a) Minimize the following expression using k-map and draw its logic circuit diagram using only 2 input NAND gates 8

$$Y = \Sigma\, m\,(3,5,6,7,11,13,14,15) + d(9,10,12)$$

(b) Explain with an appropriate logic circuit diagram the working of 4-bit 2's complement adder-subtractor. 7

Q3 (a) Explain the working of a MOD 12 counter with the help of its circuit diagram. Draw its output waveform and also write its truth table. 10

(b) Explain with the help of relevant diagram the working of Decimal to BCD Encoder. 5

Q4 (a) Draw the circuit of a Monostable Multivibrator using IC 555 timer and explain its operation. Derive the expression for its frequency. 8

(b)	Draw the block diagram of Parallel in Serial Out shift register and explain its working.	7
Q5 (a)	Draw a logic circuit of 1-to-16 Demultiplexer and explain its functioning.	8
(b)	Explain the working of a Master-Slave JK flip flop using logic circuit diagram. How does it overcome racing problem?	7
Q6 (a)	Draw the functional block diagram of 8085 microprocessor.	10
(b)	Write an assembly language program to add two numbers 53H and A4H stored in memory location 2000H and 2001H respectively. Store the result at location 2002H and carry, if any, at 2003H.	5
Q7 (a)	Describe the different addressing modes in 8085 microprocessor. Give one example of each addressing mode.	10
(b)	Distinguish between MOV and MVI instruction. Give one example of each.	5

~~SET~~ A (11) 15/12/17

[This question paper contains 2 printed pages]

Sl. No. of Q.P : 5996

Unique Paper Code : **2221303**

F-9

Name of the Paper : **Waves and Optics**

Name of the Course : ~~**ErstwhileFYUP**~~ B.Sc (Hons.) Physics

Semester : **III**

Duration :**3 hours** Maximum Marks : **75**

Attempt *five* questions in all including Question no. **1** which is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5x3=15

   (a) What are Lissajous figures? Give any two applications of Lissajous figures.

   (b) Describe plane waves and spherical waves.

   (c) Explain the Stoke's analysis of phase change on reflection.

   (d) A transparent film of glass of refractive index 1.50 is introduced normally in the path of one of the interfering beams of a Michelson's interferometer, which is illuminated with light of wavelength 4800 Å. This causes 500 dark fringes to sweep across this field. Determine the thickness of the film.

   (e) Calculate the least width of a plane diffraction grating having 500 lines/cm, which just resolves the sodium lines of wavelengths 5890 Å and 5896Å in the second order.

   (f) Distinguish between Fraunhofer and Fresnel classes of diffraction.

2. (a) Using the rotating vector representation, obtain the resulting motion of a particle subjected simultaneously to two SHM's in the same direction having equal amplitudes and equal frequencies and differing in phase by $\pi/4$. 10

   (b) Construct the Lissajous figure for the following if $\gamma = \pi$: 5

   $x = 2\cos(2\omega t + \gamma)$ and $y = 2\cos(\omega t)$.

3. (a) Distinguish between 'Division of wavefront' and 'Division of amplitude'. Give two examples of each type. 5

   (b) Obtain Airy's formula for the intensity of transmitted light in a Fabry-Perot interferometer. 10

4. (a) What is a plane diffraction grating? Give the necessary theory to derive expression for the intensity distribution pattern in a plane diffraction

12

grating.

(b) Calculate the aperture of the objective of a telescope which may be used to resolve stars separated by 4.88×10^{-6} radian for light of wavelength 6000 Å. 3

5. (a) State and explain any five properties of Cornu's spiral. 7

(b) Explain the Fresnel diffraction pattern due to a straight edge using Cornu's spiral. Derive expressions for positions of maximum and minimum intensity. 8

6. (a) What is Huygens principle? Using Huygens conception show that μ is equal to the ratio of wave velocities in the two media. 7

(b) Derive an expression for the diameter of n^{th} dark ring formed by reflected light in Newton's rings method. 8

7. Write short notes on any *three* of the following:

(a) Linearity and Superposition Principle

(b) Haidinger and Fizeau fringes

(c) Spatial and Temporal Coherence (5×3=15)

(d) Kirchoff's Integral Theorem

This question paper contains 4+2 printed pages] (12) 8/12/17

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **6673**

Unique Paper Code : **32221301** **HC**

Name of the Paper : **Mathematical Physics—II**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Question No. **1** is compulsory.

Attempt *five* questions in all.

In the question paper $y \equiv y(x)$, $y' \equiv \dfrac{dy}{dx}$ and $y'' \equiv \dfrac{d^2y}{dx^2}$.

1. Attempt any *five* questions :

(*a*) Evaluate the integral :

$$I = \int_0^1 \sqrt{y(1-y)dy}.$$

P.T.O.

(*b*) Identify and name the singularities (if any) of the following differential equations :

(*i*) $(1 - x)y'' - (2x - 1 - x^2)y' + (x - 1)y = 0$

(*ii*) $y'' - \frac{x}{x-1}y' + \frac{3x}{(1-x)^2}y = 0.$

(*c*) Show that for Legendre polynomials :

$$xP'_n = nP_n + P'_{n-1}.$$

(*d*) Demonstrate the linear dependence of $J_n(x)$ and $J_{-n}(x)$ where n is an integer.

(*e*) Determine if the following functions are odd, even or neither of them :

(*i*) $f(x) = |x|$ if $-5 < x < 5$.

(*ii*) $g(x) = \begin{cases} \cos(-x) & \text{if } -\pi < x < 0 \\ \cos(x) & \text{if } \ 0 < x < \pi \end{cases}$

(*iii*) $h(x) = \sin(x)$ if $-\pi < x < \pi$.

(*f*) A guitar has six strings of equal length. They are arranged in such a way that the mass of each string is larger than the previous one. Also the tension in each of them can be controlled. Which string will produce the sound of highest pitch ? How can one manipulate the frequency of the sound emanating from each string ?

(*g*) Find the value of y if :

$$y'' = -y.$$ 5×3=15

2. (*a*) The 1-D wave equation is given as :

$$\frac{\delta^2 y(x,t)}{\delta x^2} = c^2 \frac{\delta^2 (x,t)}{\delta t^2}.$$

Derive the same for a stretched string clearly mentioning the necessary assumptions.

(*b*) Evaluate :

$$\int_0^{\pi/2} \sin^4(\theta)\cos^5(\theta)\, d\theta.$$ 12+3=15

3. (*a*) The Rodrigue's formula for Legendre polynomials is given as :

$$P_n(x) = \frac{1}{n!2^n}\frac{d^n}{dx^n}\left(x^2 - 1\right)^n.$$

Prove the validity of the entity.

(*b*) Find the value of :

$$\int_{-1}^{1} x^2 P_5(x)\,dx.$$

10+5=15

4. The general Bessel's equation is given as :

$$x^2y'' + xy' + (x^2 - v^2)y = 0.$$

Starting from the Bessel's equation, obtain the expression of the Bessel's function of first kind. Also obtain the second solution of the Bessel's equation if v is not an integer. 15

5. (*a*) State if the given function $f(x)$ is an odd function. Find its Fourier series expansion :

$$f(x) = \frac{x^2}{2} \text{ if } -\pi < x < \pi.$$

(*b*) Determine the value of 'D' and 'E' if :

$$D = 1 + \frac{1}{4} + \frac{1}{9} + \frac{1}{16} + \ldots\ldots\ldots\ldots \text{ and}$$

$$E = 1 - \frac{1}{4} + \frac{1}{9} - \frac{1}{16} + - \ldots\ldots\ldots\ldots$$

9+6=15

6. (*a*) Show that :

$$\beta(m, n) = \frac{\Gamma(m)\Gamma(n)}{\Gamma(m+n)}.$$

(*b*) Demonstrate that :

$$\Gamma\left(\frac{1}{2}\right) = \sqrt{\pi}.$$

(*c*) State and prove the Parseval's identity associated with Fourier series. 3×5=15

7. Solve the following differential equation :

$$xy'' + (1 - x)y' + \lambda y = 0.$$

Here λ is a real constant. Show that one of the solutions of this equation becomes a polynomial of order 'n' if $\lambda = n = 0, 1, 2, \ldots\ldots$ Name the Polynomial. 15

(13)

[This question paper contains 4 printed pages.]

13/12/17

Your Roll No...............

Sr. No. of Question Paper : 6674 HC

Unique Paper Code : 32221302

Name of the Paper : Thermal Physics

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : III

Duration : 3 Hours Maximum Marks : 75

Instructions for Candidates

1. Write your Roll No. on the top immediately on receipt of this question paper.
2. Attempt **five** questions in all, including **Question No. 1** which is compulsory.
3. **All** questions carry equal marks.

1. Answer any five of the following:

(a) Distinguish between first and second order phase transitions with the help of phase diagrams.

(b) Show that the slope of an adiabatic is γ times the slope of an isothermal passing through a common point.

P.T.O.

(c) At what temperature, pressure remaining constant, will the RMS velocity of H_2 gas be doubled of its Value at NTP?

(d) Define extensive and intensive thermodynamic variables. Give one example of each.

(e) Find an expression for work done during the adiabatic expansion of an ideal gas.

(f) What is the advantage of T-S diagram over P-V diagram of a Carnot cycle?

(g) Establish the relation $U = F - T\left(\frac{\partial F}{\partial T}\right)v$ where the symbols have their usual meanings. (5×3=15)

2. (a) Write Kevin-Planck statement and Clausius statement of second law of thermodynamics. Show that the violation of one leads to the violation of the other one.

(b) The efficiency of a Carnot engine changes from 1/6 to 1/3 when the source temperature is raised by 100 K. Calculate the temperature of the sink.

(c) Prove $Es/E_T = C_p / C_v = \gamma$, Where E_s and E_T are the adiabatic and isothermal elasticities of a substance. (5,5,5)

3. (a) Derive an expression for change in entropy of a perfect gas in terms of temperature and pressure. Show that there is always an increase in entropy during an irreversible process.

(b) Formulate second law of thermodynamics in terms of entropy.

(c) One mole of an ideal gas (γ = 1.4), initially at 17°C, is compressed adiabatically so that its pressure become 10 times its original value. Find its final temperature. (7,4,4)

4. (a) Using various thermodynamical potentials derive Maxwell's four thermodynamical relations.

b) Using suitable Maxwell's thermodynamical relations, prove

(i) $C_P - C_V = T\left(\frac{\partial P}{\partial T}\right)v\left(\frac{\partial V}{\partial T}\right)P$

(ii) $\left(\frac{\partial V}{\partial V}\right)T = T\left(\frac{\partial P}{\partial T}\right)v - P$ (9,6)

5. (a) Derive Maxwell-Boltzmann distribution law of molecular velocities for a perfect gas. Hence find the expression for the most probable and root mean square velocities.

(b) Briefly discuss any experiment for the verification of Maxwell-Boltzmann distribution law. (12,3)

6. (a) Draw the schematic arrangement of Porous-Plug experiment and discuss its important results.

(b) Derive expression for Joule - Thomson coefficient for a

(i) Perfect gas and

(ii) Real gas (9,6)

7. (a) Derive expression for critical constants in terms of van der Waal's constants and hence show that RTc / PcVc = 8/3, where R is universal gas constant.

(b) Derive van der Waal's equation in terms of reduced formula of P_r, V_r and T_r. (9,6)

8. (a) What are transport phenomena? Derive an expression for coefficient of viscosity on the basis of kinetic theory.

(b) What is magneto-caloric effect? Give principle and experimental method to produce low temperature by adiabatic demagnetization. (9, 6)

(14)

This question paper contains 4 printed pages]

16/12/17

Roll No. | | | | | | | | | | | |

S. No. of Question Paper : **6675**

Unique Paper Code : **32221303** **HC**

Name of the Paper : **Digital System and Applications**

Name of the Course : **B.Sc. (Hons.) Physics**

Semester : **III**

Duration : **3 Hours** Maximum Marks : **75**

(Write your Roll No. on the top immediately on receipt of this question paper.)

Attempt *five* questions in all.

Question No. **1** is compulsory.

All questions carry equal marks.

1. Attempt any *five* of the following : 5×3=15

   (*a*) What is meant by SSI, LSI and VLSI in integrated circuits ?

   (*b*) Explain K-map simplification for sum-of-products method.

   (*c*) Using 2's complement method perform the following subtraction :

   (1001011001011001).

   10010110 — 01011001

(d) How many bytes are used in the hex code of the following instructions :

MOV L, A; CMP B; JPE 2010 ?

(e) What is the function of Stack Pointer ?

(f) Explain briefly 8-to-1 Multiplexer and 3-to-8 Decoder.

(g) What is the difference between a Combinational circuit and a Sequential circuit. Give *one* example of each type.

2. (a) Using K-map solve the following function :

$F(A, B, C, D) = \Sigma m\ (1, 3, 5, 7, 9, 12, 13) + d(10, 14)$

and draw a NOR-NOR gate circuit using duality theorem.

(b) Draw the block diagram of a Cathode Ray Oscilloscope and explain Electron Gun, Deflection system, Time base and Deflection sensitivity. $2\times7\frac{1}{2}=15$

3. (a) Design a 4-to-16 decoder using a NOT gate and two 3-to-8 decoders, and draw its truth table.

(b) Explain the working of a JK flip-flop. Which are the Synchronous and Asynchronous inputs in a flip-flop. $2\times7\frac{1}{2}=15$

4. (a) Draw and explain a 4-bit universal shift register circuit capable of performing all four shift functions viz. Serial In-Serial Out; Serial In-Parallel Out; Paralle In-Serial Out; and Parallel In-Parallel Out.

(b) Explain in detail the working of a Monostable Multivibrator. $2\times7\frac{1}{2}=15$

5. (a) Draw the circuit, waveform and truth table of a Decade Counter.

(b) Draw the circuit of a 4-bit Adder/Subtractor using controlled inverter and full adders. Under what conditions this circuit works as an Adder circuit or a Subtractor circuit. $2\times7\frac{1}{2}=15$

6. (a) Draw the memory map (with diagram) of 2048 Bytes of Memory if only memory chips of 1KBytes are available. Choose the starting address of memory location as 4000H.

(*b*) Draw the pin-out diagram of an intel 8085 microprocessor and explain in detail the purpose of the following : Multiplexed Address/Data Bus; Externally initiated signals; Control and status signals. $2 \times 7\frac{1}{2} = 15$

7. (*a*) Draw the timing diagram of MOV D, C (code : 51H) instruction and explain it.

(*b*) Using a schematic diagram explain how the $AD_7 - AD_0$ bus is demultiplexed and the role of ALE signal in this process. $2 \times 7\frac{1}{2} = 15$