

(A11) F.E. (Rev) CBGS, Sem. II,  
Applied Maths.

Date : 22/11/16

Q.P. Code : 529901

3 Hours

Total Marks : 80

(1) N.B.:- Question no 1 is compulsory.

(2) Attempt any THREE questions out of remaining FIVE questions.

1) a) Solve  $\left[ \log(x^2 + y^2) + \frac{2x^2}{x^2 + y^2} \right] dx + \left( \frac{2xy}{x^2 + y^2} \right) dy = 0$  (4)

b) Solve  $(D^4 + 2D^2 + 1)y = 0$  (3)

c) Evaluate  $\int_0^{\infty} e^{-x^5} dx$  (3)

d) Express the following integral in polar co-ordinates:  $\int_0^a \int_r^{\sqrt{a^2 - y^2}} f(x, y) dx dy$  (4)

e) Prove that  $E = 1 + \Delta = e^{ht}$  (3)

f) Evaluate  $I = \int_0^{\pi/2} \int_{\pi/2}^{\pi} \cos(x + y) dx dy$  (3)

2 a) Solve  $\frac{dy}{dx} + \frac{y}{x} \log y = \frac{y}{x^2} (\log x)^2$ . (6)

b) Change the order of integration and evaluate  $I = \int_0^2 \int_{\sqrt{2y}}^2 \frac{x^2 dx dy}{\sqrt{(x^4 - 4y^2)}}$  (6)

c) Evaluate  $\int_0^{\pi/2} \frac{dx}{1 + a \sin^2 x}$  and deduce that  $\int_0^{\pi/2} \frac{\sin^2 x dx}{(3 + a \sin^2 x)^2} = \frac{\pi \sqrt{3}}{96}$  (8)

3 a) Evaluate  $I = \int_0^a \int_0^{x+y} \int_0^z e^{x+y+z} dx dy dz$  (6)

b) If mass per unit area varies as the square of the ordinate of a point, find the mass of a lamina bounded by the cycloid  $y = a(1 - \cos \theta)$ ,  $x = a(\theta + \sin \theta)$  and the ordinates from the two cusps and the tangents at the vertex (6)

c) Solve  $(2x + 1)^2 \frac{d^2 y}{dx^2} - 6(2x + 1) \frac{dy}{dx} + 16y = 8(2x + 1)^2$  (8)

4 a) Show that the length of the arc of the parabola  $y^2 = 4ax$  cut off by the line (6)

$$3y = 8x \text{ is } a \left[ \log 2 + \frac{15}{16} \right]$$

b) Solve  $\frac{d^3 y}{dx^3} - 7 \frac{dy}{dx} - 6y = \cos x \cosh x$  (6)

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- c) Using fourth order Runge-Kutta method, find  $u(0.4)$  of the initial value problem (8)  
 $u' = -2tu^2$ ,  $u(0)=1$  take  $h = 0.2$ .

- 5 a) Use method of variation of parameters to solve  $\frac{d^2y}{dx^2} - 5\frac{dy}{dx} + 6y = e^{2x}x^2$ . (6)

- b) Using Taylor's series method, obtain the solution of  $\frac{dy}{dx} = 3x + y^2, y(0) = 1$  (6)

Find the value of  $y$  for  $x = 0.1$  correct to four decimal places

- c) Find the value of the integral  $\int_0^1 \frac{x^2}{1+x^3} dx$  by taking  $h=0.2$ , using (8)

(i) Trapezoidal Rule (ii) Simpson's 1/3 Rule.

Compare the errors with the exact value of the integral

- 6 a) A condenser of capacitance  $C$  is charged through a resistance  $R$  by a steady (6)  
 voltage. The charge  $Q$  satisfies the DE  $R\frac{dQ}{dt} + \frac{Q}{c} = V$ . If the plate is chargeless  
 find the charge and the current at time 't'

- b) Evaluate  $\iint \frac{(x^2 + y^2)^2}{x^2 y^2} dx dy$  over the region common to  $x^2 + y^2 - ax = 0$  and (6)

$$x^2 + y^2 - by = 0, a > 0, b > 0?$$

- c) Find the volume common to the right circular cylinder  $x^2 + y^2 = a^2$  and (8)  
 $x^2 + z^2 = a^2$

(2 Hours)

[Marks : 60]

- N.B. (1) Question no 1 is compulsory.  
(2) Attempt any three questions from the remaining questions.  
(3) Assume suitable data and symbols if required.  
(4) Figures on the right indicate full marks.

1. Attempt any five: 15
- (a) Why the Newton's rings are circular and fringes in wedge shaped film are straight?
  - (b) What is Rayleigh's criteria of resolution? How to increase resolving power diffraction grating?
  - (c) A fibre cable has an acceptance angle of  $30^\circ$  and core index of refractive index 1.4. Calculate the refractive index of cladding.
  - (d) What is pumping in Laser? Give the types of pumping.
  - (e) An electron is bound in one dimensional potential well of width  $2.5 \text{ \AA}$  that of infinite height find its energy in first excited state.
  - (f) How Lissajous figures are used to measure unknown frequency.
  - (g) Why is superconductor is termed as perfect diamagnet?
2. (a) For Newton's ring, prove that diameters of  $n^{\text{th}}$  dark ring is directly proportional to the square root of natural number. In Newton's ring experiment the diameter of  $n^{\text{th}}$  and  $(n+8)^{\text{th}}$  bright rings are 4.2mm and 7mm respectively. Radius of curvature of lower surface of lens is 2m. Determine the wavelength of light used. 08
- (b) What is monomode and multimode fibre? Explain the term V-number calculate the no of modes an optical fibre of  $40 \mu\text{m}$  will transmit as its core and cladding refractive indices are 1.5 and 1.46 respectively. Wavelength of light used is  $1.5 \mu\text{m}$ . 07
3. (a) What is the fundamental principle of a Hologram? How is it produced and how is the image constructed by it? 08
- (b) Why we see beautiful colours in thin film when it is exposed to sunlight? Obtain expression for path difference between two reflected rays in thin transparent film of uniform thickness and write the conditions of maxima & minima. 07

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4. (a) What is grating element? Derive condition for absent spectra in plane transmission grating and explain with example. 05
- (b) What is Heisenberg's uncertainty principle? An electron has a speed of 300 m/sec. With an accuracy of 0.001%. Calculate the certainty with which we can locate the position of an electron. 05
- (c) What do you mean by critical magnetic field and critical temperature? A lead superconductor with  $T_c=7.2\text{k}$  has critical magnetic field of  $6.5 \times 10^3 \text{ A/m}$  at absolute zero. What would be the magnitude of critical magnetic field at 5k temperature? 05
5. (a) In plane transmission grating the angle of diffraction for the second order principal maxima for the wavelength  $5 \times 10^{-5} \text{ cm}$  is  $35^\circ$ . Calculate the no. of lines/cm on diffraction grating. 05
- (b) Derive one dimensional time independent Schrodinger wave equation for matter wave. 05
- (c) With neat diagram explain the construction and working of Atomic force Microscope. 05
6. (a) The electron which is at rest is accelerated through a potential difference of 200V. Calculate : i) The velocity of electron  
ii) De-Broglie wavelength  
iii) Momentum. 05
- (b) Explain how Lissajous figures are used to determine the phase difference between two A.C. signals. 05
- (c) What are nano materials? Explain any two methods for synthesis of Nanoparticles. 05

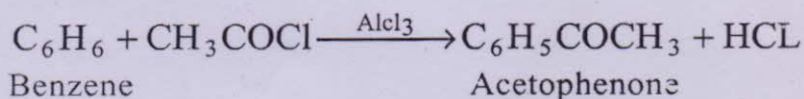
(2 Hours)

[ Total Marks : 60

- N.B. :** (1) Question No. 1 is compulsory.  
 (2) Attempt **any three** from remaining **five** questions.  
 (3) **Figures** to the **right** indicates **full** marks.  
 (4) Atomic weights : H=1, C=12, N=14, O=16, S=32, Cl = 35.5, Ba= 137.3, Mg =24, Na =23, Ca=40,

Ans-9

1. Answer **any five** from the following :- 15
- Gold and platinum do not get corroded in atmospheric oxygen. Explain.
  - Define octane number of gasoline, Name any two anti-knock agents.
  - Give compositions, properties and uses of Duralumin.
  - Give classifications of composite material.
  - What is green chemistry? List the six principles of green chemistry.
  - A coal sample was subjected to ultimate analysis 2.45 g of coal on combustion in a Bomb-Colorimeter gave 0.67 of BaSO<sub>4</sub>. Calculate percentage of sulphur.
2. (a) How do the following factors affect the rate of corrosion? 6
- Position of metal in galvanic series.
  - pH of medium
  - Relative areas of anodic and cathodic parts.
- (b) What is Biodiesel? Explain method to obtain biodiesel from vegetable oil. 5  
 What are the advantages of biodiesel.
- (c) Calculate percentage atom economy for the following reactions with respect to Acetophenone. 4



3. (a) A Gaseous fuel has the following compositions by volume :- 6
- H = 25%, CO = 20%, CH<sub>4</sub> = 30% C<sub>3</sub>H<sub>8</sub> = 20%  
 C<sub>2</sub> = 2% N<sub>2</sub> = 1%, CO<sub>2</sub> = 2% .
- Calculate volume and weighted of air required for complete combustion of 1m<sup>3</sup> of fuel (molut of air = 28.949)
- (b) Explain conventional and greener route of synthesis of Adipic Acid. Highlight the green chemistry principle involved. 5
- (c) Discuss Differential Aeration corrosion with a suitable examples. 4

4. (a) What is powder -metallurgy? List the various steps involved in powder metallurgy mention the aim of each step. 6
- (b) What is cathodic protection? Describe impressed current method of corrosion control. 5
- (c) Discuss the influence of any two chemical factors on adhesion action. 4
5. (a) What is cracking? Explain in detailed fixed bed catalytic cracking with suitable diagram. 6
- (b) What is an alloy? Explain any four purposes of alloying with suitable examples. 5
- (c) Write a note on ' Sandwich panel' type layered composites. 4
- 6 (a) What are metallic coatings? Distinguish between galvanizing and Tinning. 5
- (b) Calculate the weight and volume of air needed for complete combustion of 2 kg of coal containing :- 5  
C=54%, H=6.5 %, O=3% , W=1.8%  
mol. wt of air = 28.949).
- (c) Write a note on following :- 5  
(i) Compacting (ii) Sintering
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