D 91716 (Pages : 3) Name.....

Reg. No.....

# THIRD SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION
# NOVEMBER 2020

Physics/Applied Physics

PHY 3B 03/APY 3B 03—MECHANICS

Time : Three Hours Maximum : 80 Marks

## Section A

*Answer* **all** *questions.*
*Each question carries* 1 *mark.*
*Answer in a word* **or** *phrase.*

1. A particle in uniform rectilinear motion corresponds to a straight world line. The relative position of one event with respect to another would be represented by ——————.
2. A particle of ——————— mass travels with the speed of light.
3. Work energy theorem is given by ——————.
4. The configuration of the system of N particles, moving freely in space, may be represented by the position of a single point in 3N dimensional space, which is called ——————.
5. The relation represents variation of mass with velocity is ——————.
6. An inertial frame attached with the centre of mass of an isolated system of particles is called the ——————.
7. Constraints are always related to forces which restrict the motion of the system. These forces are called ——————.

True or False :

8. Lagragian equations are invariant under Galilean transformation.
9. It is impossible to perform an experiment which will measure the state of uniform velocity of a system by observations, confined to that system.
10. All the laws of physics have the same form in all non inertial systems.

(10 × 1 = 10 marks)

## Section B

*Answer* **all** *questions*
*Each question carries* 2 *marks.*
*Answer in two* or *three sentences.*

11. What are the assumptions of Galilean transformations ?
12. State D alembert's principle ?
13. State Newton's law of action and reaction.
14. What is the negative results of Michelson-Morley experiment.
15. Explain conservation of energy in a particle.
16. State postulates of special theory of relativity.
17. Explain length contraction.

(7 × 2 = 14 marks)

## Section C

*Answer any* **five** *questions.*
*Each question carries* 4 *marks.*
*Answer in* **one paragraph.**

18. Explain the advantages of lagrangian dynamics over Newtonian approach.
19. Deduce an expression for escape velocity.
20. Explain validity of Newton's law.
21. State and deduce Kepler 's second law of planetary motion.
22. Explain inertial frames of reference with example.
23. What you mean by ether hypothesis in relativity.
24. Explain twin paradox phenomena.

(5 × 4 = 20 marks)

## Section D

*Answer any* **four** *questions.*
*Each question carries* 4 *marks.*

25. If $F = \left(2xy + z^2\right) I + x^2 j + 2xz\, k$ newton, then show that it is conservative. Calculate the amount of work done by this force in moving a particle from (0, 1, 2) to (5, 2, 7) m.

26. A clock keeps correct time. With what speed should it be moved relative to an observer so that it may seem to lose 2 minutes in 24 hours ?

27. Obtain the equation of motion of a simple pendulum by using Lagrangian method and hence deduce the formula for its time period for small amplitude oscillations

28. Calculate the speed of an electron which has kinetic energy 2 MeV.

29. The eccentricity of the earth's orbit is 0.0167. Calculate the ratio of maximum and minimum speeds of the earth in its orbit.

30. Write the Hamiltonian for a simple pendulum and deduce its equations of motion.

31. Determine the length and the orientation of a rod of length 10 metres in a frame of reference which is moving with 0.6c velocity in a direction making 30° angle with the rod.

(4 × 4 = 16 marks)

## Section E

*Answer any* **two** *questions.*
*Each question carries* 10 *marks.*

32. Explain and deduce Hamilton's equations.

33. Briefly explain and deduce Inverse square law of planetary motion.

34. Explain conservation theorems and symmetry laws.

35. Explain Galilean transformation and deduce Galilean transformation equations.

(2 × 10 = 20 marks)

D 91716 (Pages : 3) Name.....

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# THIRD SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Physics/Applied Physics

PHY 3B 03/APY 3B 03—MECHANICS

Time : Three Hours Maximum : 80 Marks

## Section A

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6. An inertial frame attached with the centre of mass of an isolated system of particles is called the ——————.
7. Constraints are always related to forces which restrict the motion of the system. These forces are called ——————.

True or False :

8. Lagragian equations are invariant under Galilean transformation.
9. It is impossible to perform an experiment which will measure the state of uniform velocity of a system by observations, confined to that system.
10. All the laws of physics have the same form in all non inertial systems.

(10 × 1 = 10 marks)

**Turn over**

## Section B

*Answer* **all** *questions*
*Each question carries* 2 *marks.*
*Answer in two* or *three sentences.*

11. What are the assumptions of Galilean transformations ?
12. State D alembert's principle ?
13. State Newton's law of action and reaction.
14. What is the negative results of Michelson-Morley experiment.
15. Explain conservation of energy in a particle.
16. State postulates of special theory of relativity.
17. Explain length contraction.

(7 × 2 = 14 marks)

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*Answer any* **five** *questions.*
*Each question carries* 4 *marks.*
*Answer in* **one paragraph**.

18. Explain the advantages of lagrangian dynamics over Newtonian approach.
19. Deduce an expression for escape velocity.
20. Explain validity of Newton's law.
21. State and deduce Kepler 's second law of planetary motion.
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24. Explain twin paradox phenomena.

(5 × 4 = 20 marks)

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*Each question carries* 4 *marks.*

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(4 × 4 = 16 marks)

## Section E

*Answer any* **two** *questions.*
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32. Explain and deduce Hamilton's equations.

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34. Explain conservation theorems and symmetry laws.

35. Explain Galilean transformation and deduce Galilean transformation equations.

(2 × 10 = 20 marks)

D 91758 (Pages : 3) Name.....

Reg. No.....

# THIRD SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

## Applied Physics

## APY 3C 03—OP-AMP AND APPLICATIONS

Time : Three Hours Maximum : 64 Marks

### Section A

*Answer* **all** *questions.*
*Each question carries* 1 *mark.*

1. In a typical 8 pin linear op-amp the supply voltages + $V_{CC}$ and – $V_{CC}$ are applied to the pins ———— respectively.

   (a) 5 and 2. (b) 6 and 3.

   (c) 7 and 4. (d) 8 and 1.

2. Which of the following is a true statement :

   (a) An op-amp amplifies the two input voltages.

   (b) An op-amp amplifies the difference of two input voltages.

   (c) An op-amp amplifies the sum of two input voltages.

   (d) An op-amp amplifies the average of two input voltages.

3. Gain of an op-amp in inverting mode with $R_F$ = 20 K and $R_1$ = 10 K is :

   (a) + 0.5. (b) – 0.5.

   (c) + 2.0. (d) – 2.0.

4. Value of CMRR for a typical IC 741 is about :

   (a) 1 dB. (b) 100 dB.

   (c) 1000 dB (d) 1000,000 dB.

5. The output voltage of an op-amp changes by 20 V in μs. The slew rate is :

   (a) 80 Vμs. (b) 4V/μs.

   (c) 0.25 μs/V. (d) 0.01 $(V\mu s)^{-1}$.

Turn over

6. Maximum gain of a filter is 6 dB. The gain at the cutoff frequency will be :

(a 12 dB. (b) 9 dB.

(c) 3 dB. (d) 0 dB.

7. The output waveform of a differentiator amplifier with square wave input will be :

(a) Spike. (b) Saw tooth.

(c) Triangular. (d) Sinusodial.

8. In an integrator using op-amp after gain limiting frequency the gain decreases at a rate of :

(a) 3 dB/decade. (b) 10 dB/decade.

(c) 20 dB/decade. (d) 40 dB/decade.

9. A device used to convert one form of energy to another form is called :

(a) Instrumentation amplifier. (b) Comparator.

(c) Transducer. (d) Oscillator.

10. In a second order low pass filter an input resistance 27K is used. The resistance to be choosed as feedback resistance is about :

(a) 10 K. (b) 15 K.

(c) 48 K. (d) 100 K.

(10 × 1 = 10 marks)

## Section B

*Answer* **all** *questions.*
*Each question carries 2 marks.*

11. Draw the pinout diagram of IC 741 and lebel its terminals.

12. Explain the virtulal ground of an operational amplifier.

13. Draw the circuit of a unity follower.

14. Draw the output waveform of an integrator amplifier using op-amp for a square wave input signal.

15. Write the expressions for gain and cutoff frequency of a second order high pass filter.

16. What is a triangular wave generator. Draw the input and output wave form.

17. What are voltage limiters ?

(7 × 2 = 14 marks)

## Section C

*Answer any* **three** *questions.*
*Each question carries* 4 *marks.*

18. Draw and explain equivalent circuit of an operational amplifier.
19. Explain open loop differential amplifier.
20. Discuss voltage transfer curve of an operational amplifier.
21. Explain summing amplifier in non invering configuaration with three input voltages.
22. Explain intergrator circuit with an operational amplifier.

(3 × 4 = 12 marks)

## Section D

*Answer any* **three** *questions.*
*Each question carries* 4 *marks.*

23. In an op-amp circuit, the common mode gain is 10 and the closed loop gain is 0.001. Calculate CMRR. Also express it in dB.
24. An operational amplifier in non inverting mode with input resistance is 2.2K and a feedback resistance is 22K. An alternating signal of 0.2V peak to peak is applied to it. Calculate output voltage and volage gain in dB.
25. Draw the frequecy response of a low pass filter for a cutoff frequency =1000 Hz and maximum gain = 2. Explain how can you determine cutoff frequency and rolloff rate from the graph ?
26. A summing operational amplifier circuit in inverting mode, three input voltages + 0.1V, + 0.2V and -0.3V are applied through 200 ohm, 100 ohm and 600 ohm respectively. Calculate the output voltage if the feedback resistance used is 1000 ohm.
27. Briefly explain comparator characteristics.

(3 × 4 = 12 marks)

## Section E

*Answer any* **two** *questions.*
*Each question carries* 8 *marks.*

28. Breifly explain important parameters of a typical practical operational amplifier.
29. Explain with circuit in inverting configuration with three inputs that can be used as summing amplifier, scaling amplifier and averaging amplifier.
30. Explain the circuit of a first and second order low pass filters using operational amplifier. Draw the frequency response.
31. Explain Schmitt trigger circuit using operational amplifier. Draw the input and output waveforms.

(2 × 8 = 16 marks)

Name.....

Reg. No.....

# THIRD SEMESTER (CBCSS–UG) DEGREE EXAMINATION, NOVEMBER 2020

Physics/Applied Physics

APH 3C 03—DIGITAL INTEGRATED CIRCUITS

Time : Two Hours Maximum : 60 Marks

*The symbols used in this question paper have their usual meanings*

## Section A (Short Answer Type)

*Answer at least* **eight** *questions.*
*Each question carries* 3 *marks.*
*All questions can be attended.*
*Overall Ceiling* 24.

1. Why NAND gate is called a universal gate ?
2. State and explain De Morgan's theorems.
3. Using Boolean algebra, verify $(A+B)\cdot(A+\overline{B}) = A$.
4. Convert the following expression into other canonical form :

$$X = \sum m(1, 4, 5, 6, 7).$$

5. Why CMOS ICs are widely used in watches and calculators ?
6. What is meant by edge triggering ?
7. What is meant by race around condition in flip-flops ?
8. Explain the truth table and working of a clocked RS flip-flop.
9. Mention two applications of a shift register.
10. What is the basic difference between synchronous and asynchronous counters ?
11. How many flip-flops are needed to count ten states from 0000 to 1001 ?
12. What is a multiplexer ?

(8 × 3 = 24 marks)

## Section B (Paragraph/Problem Type)

*Answer at least* **five** *questions.*
*Each question carries* 5 *marks.*
*All questions can be attended.*
*Overall Ceiling* 25.

13. Using Boolean algebra show that :

(i) $(A\overline{A} + AC)(\overline{A}B + C)(\overline{A}BC + \overline{C}) = 0.$

(ii) $\overline{A}\overline{B}\overline{C} + \overline{A}B\overline{C} + A\overline{B}\overline{C} + AB\overline{C} = \overline{C}.$

**Turn over**

14. Using Karnaugh map, obtain a simplified Boolean equation for the following logic equation expressed by interms $Y = F(A, B, C, D) = \sum m(7, 9, 10, 11, 12, 13, 14, 15)$.

15. Explain the working of a TTL NAND gate.

16. Explain the working of a CMOS NOR gate.

17. With logic circuit, truth table and timing diagram explain the operation of master- slave JK flip-flop ?

18. With logic circuit explain the operation of a mod-8 ripple counter.

19. Explain the principle of a BCD to decimal Decoder.

(5 × 5 = 25 marks)

## Section C (Essay Type)

*Answer any* **one** *question.*
*The question carries* 11 *marks.*

20. What are the merits of CMOS over TTL ? Explain different methods to interface a CMOS to TTL.

21. Explain how a digital signal is converted into the corresponding analog signal using an R- 2R ladder network.

(1 × 11 = 11 marks)

**D 92966** (Pages : 2) Name.....

Reg. No.....

# THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION, NOVEMBER 2020

Physics/Applied Physics

PHY 3C 03—MECHANICS, RELATIVITY, WAVES AND OSCILLATIONS

Time : Two Hours Maximum : 60 Marks

*The symbols used in question paper have their usual meanings.*

## Section A (Short Answer Type)

*Answer at least* **eight** *questions.*
*Each question carries* 3 *marks.*
*All questions can be attended.*
*Overall Ceiling* 24.

1. What do you mean by an inertial frame of reference ? Are all frames moving with constant velocity w.r.t. an inertial frame inertial ?
2. Write down the Galilean law of addition of velocities. Prove that the acceleration of a particle relative to two inertial frames are identical.
3. Discuss the Coriolis force effects caused by the rotation of earth.
4. Draw a potential energy versus distance curve to indicate stable and unstable equilibria.
5. Write down the relation between torque and angular momentum. What is the unit of torque ?
6. Write down the postulates of the special theory of relativity.
7. What is twin paradox ?
8. What do you mean by a simple pendulum ? Give an expression for its time period.
9. What do you mean the energy density of a wave ? Does it depend on time ?
10. What is Photoelectric effect ? Write down Einstein's photoelectric equation.
11. What is de Broglie hypothesis ? Give an expression for the de Broglie wavelength.
12. Give expressions for energy and momentum operators.

(8 × 3 = 24 marks)

## Section B (Paragraph/Problem Type)

*Answer at least* **five** *questions.*
*Each question carries* 5 *marks.*
*All questions can be attended.*
*Overall Ceiling* 25.

13. What are Coriolis and centrifugal forces ? Give expressions for the same. Describe the terms involved.

**Turn over**

14. Verify whether the force $F = \left(2xy + yz^2\right)\hat{i} + \left(x^2 + xz^2\right)\hat{j} + 2xyz\,\hat{k}$ is conservative or not.

15. Amplitude of a damped harmonic oscillator is reduced to 1/10th of its initial value after 100 oscillations. If the time period of oscillation is 2 seconds, determine the damping constant.

16. What do you mean by a plane progressive harmonic wave ? Obtain an expression for a plane progressive harmonic wave.

17. Estimate the increase in relativistic mass of a particle of rest mass 1 gram when it is moving with velocity 0.8c.

18. The work function for barium is 2.5 eV. Check whether barium can be used as a photo cell to detect visible light. Note that the visible range of the electromagnetic spectrum is 400-700 nm.

19. The average period that elapses between the excitation of an atom and the time it emits radiation is $10^{-10}$ s. Determine the width of the excited state.

(5 × 5 = 25 marks)

## Section C (Essay Type)

*Answer any* **one** *question.*
*The question carries* 11 *marks.*

20. Explain the conservation theorems of energy, linear and angular momentum.

21. Obtain the Lorentz transformation equations for co-ordinates and time for two inertial frames.

(1 × 11 = 11 marks)

**D 92965** (Pages : 2) Name.....

Reg. No.....

# THIRD SEMESTER (CBCSS—UG) DEGREE EXAMINATION
# NOVEMBER 2020

Physics/Applied Physics

PHY 3B 03/APH 3B 03—ELECTRODYNAMICS—I

Time : Two Hours Maximum : 60 Marks

## Section A (Short Answer Type)

*Answer atleast* **eight** *questions.*
*Each question carries* 3 *marks.*
*All questions can be attended.*
*Overall Ceiling* 24.

1. What do you mean by the cross product of two vectors ? Mention two properties of cross product.
2. Give the geometrical interpretation of the gradient of a quantity.
3. Give the basic features of a one dimensional Dirac delta function.
4. Write down the relation connecting electric field and electric potential. Write its differential form.
5. Prove that the potential difference between two points $a$ and $b$ is equal to the work done per unit charge required to carry the particle from $a$ to $b$.
6. List the basic electrostatic properties of ideal conductors.
7. What happens when a dielectric made of non-polar molecules is placed in an electric field ? What do you mean by the term polarization ?
8. Write down the relation connecting electric field, polarization and electric displacement. Can we express electric displacement as the gradient of a scalar potential ?
9. What happens when a dielectric is placed near the plates of a parallel plate capacitor ? Explain the term fringing field.
10. Write down Lorentz force law. Why magnetic forces do no work ?
11. Write down Maxwell's equations for magnetostatics.
12. Compare the behavior of paramagnetic and diamagnetic materials in a non-uniform magnetic field.

(8 × 3 = 24 marks)

## Section B (Paragraph/Problem Type)

*Answer atleast* **five** *questions.*
*Each question carries* 5 *marks.*
*All questions can be attended.*
*Overall Ceiling* 25.

13. Using the expression for an infinitesimal volume element in spherical polar co-ordinates, determine the volume of a sphere.

14. Explain the Gauss's divergence theorem. Discuss its geometrical interpretation.

15. Obtain Poisson's and Laplace's equations in electrostatics.

16. A metal sphere of radius $a$ carries a charge Q. It is surrounded, out to radius $b$, by a linear dielectric material of permittivity $\varepsilon$. Determine the potential at the centre (relative to infinity).

17. Find the magnetic field at a distance $z$ above the centre of a circular loop of radius R, which carries a steady current I.

18. An infinitely long cylinder carries a uniform magnetization M parallel to its axis. Determine the magnetic field due to M inside and outside the cylinder.

19. Draw and explain a typical ferromagnetic hysteresis curve.

(5 × 5 = 25 marks)

## Section C (Essay Type)

*Answer any* **one** *question.*
*The question carries* 11 *marks.*

20. Explain Gauss's law. Obtain the differential form of Gauss's law. Using Gauss's law, determine the field outside a uniformly charged solid sphere of radius R and total charge $q$.

21. Obtain the equation of continuity in magnetostatics. Explain the Bio-Savart Law.

(1 × 11 = 11 marks)

D 91757 (Pages : 3) Name.....

Reg. No.....

# THIRD SEMESTER (CUCBCSS—UG) DEGREE EXAMINATION NOVEMBER 2020

Physics

PHY 3C 03—OPTICS, LASER, ELECTRONICS AND COMMUNICATION

Time : Three Hours Maximum : 64 Marks

## Section A

*Answer* **all** *questions.*
*Each question carries* 1 *mark.*
*Answer in a word* **or** *a phrase.*

1. According to first law of reflection, ————, reflected ray and normal ray at the point of incidence are in ———— plane.
2. ———— are the sources of light which emit light waves of same frequency, same wavelength and have a constant initial phase difference.
3. For interference pattern, the phase difference between the two lays rays must be ————.
4. The equation for resolving power of a grating is ————.
5. The intensity of transmitted light through of polarizer is ———— the intensity of incident light.
6. In a CE amplifier phase difference between input and output is ————.
7. Zener diode can be used as a ————.
8. A NAND gate is obtained by the series combination of an AND gate and ———— gate.
9. In a ruby laser ———— ions is responsible for lasing action.
10. The medium used in radio transmission is ————.

(10 × 1 = 10 marks)

## Section B

*Answer* **all** *questions.*
*Each question carries* 2 *marks.*
*Answer in two* **or** *three sentences.*

11. Explain Fermat's principle of least time.
12. Describe the condition to obtain sustained interference pattern.

**Turn over**

13. Explain the theory of a zone plate.

14. State and explain Brewster's law.

15. Describe the action of a $\pi$-filter circuit.

16. Explain the principal operation of a semiconductor laser.

17. What is demodulation ?

(7 × 2 = 14 marks)

## Section C

*Answer any* **three** *questions.*
*Each question carries* 4 *marks.*
*Answer in* **one paragraph**.

18. For a thin film placed in air, obtain the condition for constructive interference.

19. Distinguish between Fresnel and Fraunhofer diffraction.

20. Write brief note on : (a) Quarter wave plate ; (b) Half wave plate.

21. Obtain the relation between current amplification factors $\alpha$, $\beta$ and $\gamma$.

22. Explain the principle and working of He-Ne laser.

(3 × 4 = 12 marks)

## Section D

*Answer any* **three** *questions.*
*Each question carries* 4 *marks.*

23. Light of wavelength 5839 Å is reflected at near normal incidence from a soap bubble of refractive index 1.42. What is the least thickness of the film that will appear bright by reflection ?

24. The diameter of the $m^{th}$ Newton's ring changes from 1.2 cm. to 1 cm. when the air space between the lens and the plate is replaced by transparent liquid. Find the refractive index of the liquid.

25. For a wavelength of light $\lambda$ = 6,000 Å and the redius of the first half period zone $r_1 = 6 \times 10^{-4}$ m, a zone plate brings rays to focus at its bright spot. Find the focal length of the equivalent lens.

26. Calculate the thickness of double refracting plate capable of producing path difference of $\lambda/4$ between ordinary and extra-ordinary waves. Given $\lambda = 5500$ Å, $\mu_e = 1.54, \mu_0 = 1.53$.

27. A full-wave bridge rectifier is connected to a 46 V step down transformer. If the diodes are assumed to be ideal and load resistance is 100 Ω. Find the d.c. load current and efficiency of the rectifier.

(3 × 4 = 12 marks)

## Section E

*Answer any* **two** *questions.*

*Each question carries* 8 *marks.*

28. How are coherent sources formed in a biprism ? Describe the Fresnel's biprism method of determining the wavelength of light.

29. Give the construction and theory of plane transmission grating. Obtain the condition for absent spectra.

30. Explain the working of a CE amplifier. Explain its frequency response.

(2 × 8 = 16 marks)