Q.P. Code – 42341

Third Semester B.Sc. Degree Examination, October/November 2019

(CBCS Scheme – 2016-18 Repeators)

Physics

Paper III (301) - THERMODYNAMICS LOW TEMPERATURE PHYSICS RADIATION AND OPTICS

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written Completely in English only.

PART – A

Answer any **FIVE** from the following. Each question carries 8 marks :

(5 × 8 = 40)

1. State and prove the law of equipartition of energy.

2. What is 'transport phenomena'? Derive the expression for coefficient of viscosity of gas by using kinetic theory of gases.

3. What is diesel engine? Derive the expression for efficiency of diesel engine.

4. Derive Maxwell's thermodynamic relations using thermodynami potentials.

5. Describe with necessary theory the porous-plug experiment.

6. (a) State and prove Kirchoff's law of radiation.

   (b) Give any two illustrations of Kirchoff's law. **(6 + 2)**

7. (a) What is Fresnel's Biprism?

   (b) Give the theory of Fresnel's Biprism.

8. (a) What are Newton's Rings?

   (b) Give the theory of Newton's rings by reflected light.

PART – B

Answer any **SIX** questions from the following. Each question carries 5 marks :

(6 × 5 = 30)

9. Calculate the mean free path of a gas molecule whose diameter is 5×10^{-10} m and the number of molecules per unit volume is $2.2\times10^{25}\,m^{-3}$.

10. Calculate the elevation of the boiling point of water due to a change in pressure of 1 cm of mercury. Assume $L = 2.268\times10^{6}$ J/kg and specific volume of steam as 1.671 m^3.

11. A Carnot's reversible engine absorbs 150 J of heat per cycle from the source at a temperature of 450 K. If the engine rejects 120 J of heat to the sink per cycle, what is the temperature of the sink?

12. One mole of a perfect gas expands isothermally to thrice its initial volume. Calculate the change of entropy. Given R = 8.313 J/K/mol.

13. Calculate the temperature of inversion and Joule-Thomson cooling for 2 atm. tall of pressure with the following data :

    Vander Waals constants for hydrogen are

    a = 0.247 atm $litre^2/mol^2$

    b = 2.65 10^{-2} Litre/mole

    Initial temperature = 100 k and

    R = 8.2 J/K/mole.

14. A copper furnace emits 2.6×10^{6} J of energy per hour through an area $10^{-6}\,m^2$. If the emissivity is 0.82, calculate the temperature of the furnace.

    Stefan's constant $\sigma = 5.67\times10^{-8}\,w/m^2/k^4$.

15. In Young's double slit experiment the slit separation is 2 mm and the distance between slit and screen is 1.2 m. The distance of the 6^{th} bright fringe from the central bright fringe is 10 mm. Calculate the wavelength of light and fringe width.

16. When the movable mirror of Michelson's interferometer is moved through 0.02 mm a shift of 65 fringes is observed. Calculate the wave length of light used.

PART – C

Answer any **TEN** from the following questions. Each question carries 2 marks : **(10 × 2 = 20)**

17. (a) Does co-efficient of diffusion depend on temperature. Justify.

(b) In what way ideal gas and real gases are different? Explain.

(c) Among Vrms, Vav and Vmpv, which is the greatest and which is the least?

(d) The entropy of the universe is always increasing. Justify.

(e) Among otto engine and diesel engine which one has higher efficiency at a given conditions? Explain.

(f) Food gets cooked faster in pressure cooker. Justify.

(g) Can mercury be used in diffusion pump? Why?

(h) Is energy of thermal radiation less than that of visible light? Justify.

(i) Animals curl their body during winter season. Justify.

(j) Name any two types of wave font.

(k) Soap bubbles and oil spills appears colorful. Why?

(l) What happens to fringe width if yellow light is replaced by violet light? Justify.

Q.P. Code – 22339

Third Semester B.Sc. Degree Examination, October/November 2019

(Non-CBCS - Repeaters)

Physics

Paper III (301) - ELECTRICITY MAGNETISM AND RADIATION

Time : 3 Hours] *[Max. Marks : 60*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following. Each question carries **6** marks : **(5 × 6 = 30)**

1. State and prove Thevenine's theorem. **(6)**

2. Derive an expression for magnetic field at a point on the axis of solenoid carrying current. **(6)**

3. (a) What is self inductance of a coil?

   (b) Derive an expression for energy stored in an inductor. **(2 + 4)**

4. Prove that electromagnetic waves are transverse in nature. **(6)**

5. (a) Obtain an expression for the growth of charge in RC circuit with emf E in series with R and C.

   (b) Define time constant. **(5 + 1)**

6. Derive an expression for current in LR circuit to which ac voltage in applied by J-operator method. **(6)**

7. (a) What is Thomson effect?

   (b) Describe on Expt to demonstrate Thomson effect. **(2 + 4)**

8. State and prove Kirchoff's law of radiation. **(6)**

PART – B

Answer any **FOUR** of the following. Each question carries **5** marks : **(4 × 5 = 20)**

9. A charged condenser of 2 μF is shunted by a high resistance. If half the charge leaked in 60 seconds. Find value of the high resistance.

10. A straight conductor carrying a current of 0.5 A. Find the magnetic field at a point at a distance of 0.6 cm from it.

11. A magnetic field between poles of the electromagnet is increased at the rate of 0.02 T/S. The area of conducting loop kept perpendicular to the magnetic field of area 1.2 m^2 and resistance 5Ω. Find induced emf and induced current.

12. In a series LCR circuit suppose $R = 300\Omega$, L = 60 mH C = $0.5\mu F$ V = 50 V and W = 10000 rad/s. Find the value of impedance and current in the circuit.

13. Inductor has inductance of 53 mH and resistance of 0.37Ω. If it is connected to a battery, how long will the current take to reach half of the initial value?

14. Calculate the temperature of the sun from the following data :

    Radius of the sun = 4.4×10^5 mile

    Distance of the sun from the earth = 9.2×10^7 mile.

    Solar constant = 8.4×10^4 Jm^2wn^{-1}

    Stetan's constant = 5.7×10^{-8} $wm^{-2}k^{-4}$.

PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks : **(5 × 2 = 10)**

15. (a) What is the force experienced when charge is flowing along the axis of straight conductor carrying current?

    (b) What is difference between open circuit voltage and short circuit current?

    (c) Is eddy current present in inductor? Justify.

    (d) What is the physical significance of Lenz's law? Justify.

    (e) Does time constant depend on resistance of the RC circuit? Comment.

    (f) What is the value of resistance in a pure capacitive networks?

    (g) A cloudy night is hotter than clear sky night. Why?

    (h) Peltier effect is reversible but joule heating effect is irreversible. Explain.

Q.P. Code – 42348

Third Semester B.Sc. Degree Examination, October/November 2019

(Revised Scheme CBCS - 2018 Onwards)

Physics

Paper III (301) – THERMAL PHYSICS, RADIATION AND OPTICS – I

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written in English only.

PART – A

Answer any **FIVE** of the following questions. Each question carries **8** marks : **(5 × 8 = 40)**

1. (a) Define 'most probable velocity' of a gas molecule.

   (b) Describe Stern's experiment to verify Maxwell's law of distribution of velocities of gas molecules. **(1 + 7)**

2. (a) Explain transport phenomenon.

   (b) Derive an expression for coefficient of thermal conductivity of a gas on the basis of kinetic theory of gases. **(2 + 6)**

3. (a) What is heat engine? Name the types of heat engine.

   (b) Using diesel cycle, obtain an expression for efficiency of a diesel engine. **(2 + 6)**

4. (a) Write four Maxwell's thermodynamic relations.

   (b) Obtain Clausius-Clapeyron equation using thermodynamic relations. Explain the effect of pressure on melting point of solids. **(2 + 6)**

5. (a) What is vacuum pump?

   (b) Define speed of a vacuum pump. Derive Gaede's and Langmuir's equation for the speed of vacuum pump. **(1 + 7)**

6. (a) What is a black body? Define emissive power of a body.

   (b) State and prove Stefan's law of radiation by using radiation pressure. **(2 + 6)**

7. What are Newton rings? Give the theory of Newton's rings by reflected light. **(8)**

8. What is an interferometer? Explain with a neat diagram the construction and working of Michelson interferometer. **(8)**

PART – B

Answer any **SIX** of the following questions. Each question carries **5** marks : **(6 × 5 = 30)**

9. Calculate the diameter of gas molecule which has mean free path 3.2×10^{-8} m and number of molecules per unit volume $2.6\times10^{25}\,m^{-3}$.

10. Calculate the rms velocity of oxygen molecules at 27^0C. Density of oxygen at NTP = 1.43 Kgm^{-3}.

11. A reversible heat engine converts $\left(\frac{1}{6}\right)^{th}$ of heat energy into work. When the temperature of the sink is reduced by 62 K the efficiency is doubled. Find the temperature of the source and sink.

12. Calculate change in entropy when 100 gm of ice at 0^0C is converted into water at same temperature. Given that latent heat of fusion of ice is 3.4×10^5 J/kg.

13. Calculate the J-T coefficient for oxygen at 0^0C from the following data :

Cp = 29.53 J/mol, a = 0.132 Nm^4/mol^2, b = 3.12×10^{-5} m^3/mol, R = 8.3 J/k mol.

14. A uniformly heated enclosure is maintained at a temperature of 1027^0C and has a cavity of diameter 4 mm which acts like a black body. Calculate the energy radiated per hour from the cavity ($\sigma - 5.7\times10^{-8}\,Wm^{-2}k^{-4}$).

15. In an experiment with Fresnel's biprism the fringes of 0.196 mm thick are observed 1 m away from the slit. A convex lens introduced between the Biprism and screen gives an image of the sources which are separated by 0.7 cm on the screen. If the lens is 30 cm from the slit, find the wavelength of light used.

16. A glass wedge of an angle 0.01 radian is illuminated by monochromatic light of wavelength 6000 A^0 falling normally on it. At what distance from the edge of the wedge will the 10 fringes be observed by reflected light.

PART – C

Answer any **TEN** questions from the following. Each question carries **2** marks : **(10 × 2 = 20)**

17. (a) Diatomic molecule has only two degrees of freedom for rotational motion. Justify.

(b) How does temperature and pressure affect the mean free path of gas molecule?

(c) Does coefficient of viscosity depend on pressure? Justify.

(d) Which process is called isentropic? Why?

(e) In which state entropy is maximum solid, liquid or gas? Justify.

(f) In pressure cooker water boils at higher temperature than its boiling point. Why?

(g) Can mercury be used in diffusion pump? Explain.

(h) Does ideal gas show Joule Thomson effect? Justify.

(i) Why Wien's law is called displacement law?

(j) Mention two methods by which coherent sources can be obtained by division of amplitude.

(k) An interference pattern is observed using red laser, what happens if it is replaced with blue colour?

(l) Why does a thick film not show colours?

22339

III Semester B.Sc. Examination, November/December 2015
(Semester Scheme)
PHYSICS – III (301)
Electricity, Magnetism, Radiation and Thermoelectricity

Time : 3 Hours Max. Marks : 60

***Instruction** : Answer should be written **completely** in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. State and prove superposition theorem. **(2+4)**

2. a) Define Ampere's law.
   b) Derive an expression for magnetic field along axis of a current carrying solenoid using Ampere's law. **(2+4)**

3. Define Stokes theorem and hence explain physical significance of cure of a vector. **(2+4)**

4. Derive Maxwell's equation $\vec{\nabla} \cdot \vec{B} = 0$. **6**

5. Deduce Rayleigh-Jean's law and Wein's law from Plank's radiation law. **(3+3)**

6. Determine impedance of LR circuit by j operator method. **6**

7. a) Define laws of thermo electric circuits.
   b) Give experimental demonstration of Pettier effect. **(2+4)**

8. Give principle, construction and working of Boy's radiometer. **(2+2+2)**

PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4×5=20)**

9. A vector F is defined by $\vec{F} = 5x\,\hat{i} - 7y\hat{j} - 8z\hat{k}$ calculate grad $\vec{F}$, div $\vec{F}$, curl $\vec{F}$.

P.T.O.

10. In a series LCR circuit $R = 100\ \Omega$, $L = 200$ mH, $C = 15\ \mu F$, driving frequency $f = 50$ Hz and maximum emf is 36 V. Calculate current amplitude, phase constant of the current in the circuit relative to the driving emf.

11. Calculate velocity of light in vacuum using Maxwell's electromagnetic theory. Given :

$\mu_0 = 4\pi \times 10^{-7}\ H/m$

$\varepsilon_0 = 8.846 \times 10^{-12}\ F/m$

12. A straight conductor carrying a current of 2 A produces a magnetic field around it, in an Amperian loop of radius 5 cm. Calculate strength of magnetic field so produced $\mu_0 = 4\pi \times 10^{-7}\ H/m$.

13. A coil has an inductance of 53 mH and resistance of $0.35\ \Omega$. If 10 V emf is applied across the coil how much energy is stored in the magnetic field after current has buildup to its equilibrium.

14. For a certain thermocouple the thermo emf is given by $E = at + bt^2$ temperature of hot and cold junctions are 200° C, 0° C respectively. If seebeck co-efficients are $a = 13.3\ \mu v/°C$ and $b = -0.0019\ \mu v/°C^2$. Calculate neutral and inversion temperatures.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

15. a) Is choke difference from resistance ? Explain.

b) A cloudy night is hotter than clear sky. Why ?

c) A current carrying loop behaves like a magnetic dipole. Explain.

d) Distinguish between positive and negative Thomson effect.

e) Time constant of a RC circuit is used in signal shaping. Explain.

f) If div B > 0, it predicts what ?

g) Predict colour of sun assuming its temperature as 5890 K.

h) Differentiate between conduction current and displacement current.

22339

III Semester B.Sc. Examination, November/December 2016
(Semester Scheme)
PHYSICS – III (301)
Electricity, Magnetism, Radiation and Thermoelectricity

Time : 3 Hours Max. Marks : 60

***Instruction** : Answers should be written completely in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. State and prove Thevenin's Theorem. **6**

2. Explain with necessary theory the leakage method of determination of high resistance using a Ballistic galvanometer. **6**

3. a) State and explain Faraday's Laws and Lenz's Law of Electromagnetic Induction.

   b) Give physical significance of divergence of a vector. **(4+2)**

4. Prove that the electromagnetic waves are transverse in nature. **6**

5. Obtain an expression for the growth of current in a circuit containing an inductance and a resistance connected in series with a steady emf. Define time constant of the circuit. **6**

6. a) Obtain an expression for the current in an A.C. circuit containing capacitor and resistor by j-operator method.

   b) Distinguish between inductive reactance and capacitive reactance. **(4+2)**

7. a) Define Peltier and Thomson coefficients.

   b) Describe an experiment to demonstrate Thomson effect. **(2+4)**

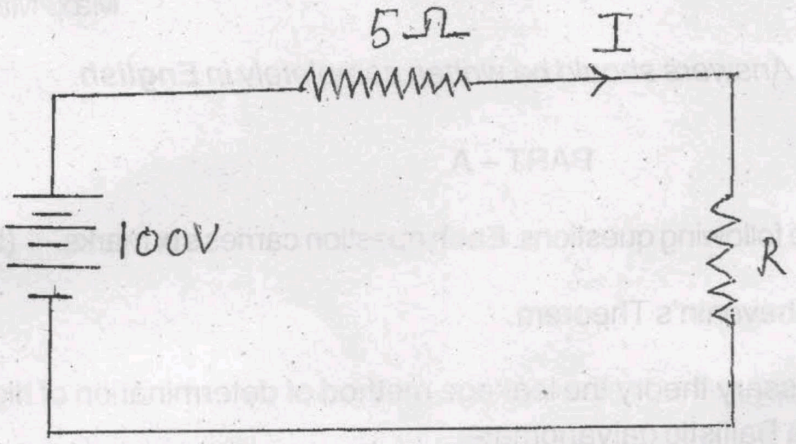
8. Define solar constant and explain how solar constant can be determined using Angstrom's Pyrheliometer. **(1+5)**

P.T.O.

PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4×5=20)**

9. For the network shown is fig., find the maximum power delivered across R.



10. A Helmholtz galvanometer has coils of radius 11×10^{-2} m and number of turns $70\sqrt{5}$. Calculate the current through the coils which produces a deflection of 45°. What will be the deflection, if the current is doubled ? $B_H = 0.32 \times 10^{-4}$ T.

11. A plane electromagnetic wave travelling along x-direction in an unbounded lossless dielectric medium of $\mu_r = 2$ and $\varepsilon_r = 5$ has a peak electric field strength of 10 Vm^{-1}. Calculate :
    i) The velocity of wave
    ii) Intrinsic impedance of the medium
    iii) Peak value of magnetic field strength and
    iv) Value of poynting vector.

12. A battery of e.m.f. 100 V is connected in series with an inductance of 10 mH, a capacitor of 0.05 μ F and the resistance of 100 Ω. Find
    i) If the circuit is oscillatory
    ii) What is the frequency of oscillatory circuit ?
    iii) Calculate the logarithmic decrement and
    iv) Charge on the condenser.

13. A series LCR circuit, the resonant frequency is 800 Hz. The half power points are obtained of frequency 745 Hz and 855 Hz. Calculate the Bandwidth of the circuit has resistance of 4 Ω and impedance of 256 Ω . Find the power factor and phase angle.

14. The Thermoemf of a Thermocouple in microvolts is given by the equation $e = 16.34\theta - 0.021\ \theta^2$ when the junctions are at 0° C and θ° C. Calculate :
    i) Thermoelectric power at 100° C
    ii) The neutral temperature
    iii) The temperature of inversion and
    iv) The Peltier e.m.f. at 100° C.

PART – C

15. Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**
    a) Explain the limitations of Ampere's law.
    b) Mention any two applications on eddy current.
    c) Distinguish between displacement current and conduction current.
    d) The concept of velocity of light has great significance. Comment.
    e) Why the parallel resonance circuit is called rejector circuit ? Explain.
    f) The bottom of a cooking vessel should be dark and rough. Explain.
    g) Is Peltier effect is reversible ? Explain.
    h) Animals curl their body when they feel cold. Why ?

22339

III Semester B.Sc. Examination, Nov./Dec. 2014
(Semester Scheme)
PHYSICS – III (301)
Electricity, Magnetism and Radiation

Time : 3 Hours Max. Marks : 60

Instructions : *Answer should be written completely in* ***English.***

PART – A

Answer **any five** of the following questions. **Each** question carries **six** marks. **(5×6=30)**

1. State and prove superposition theorem for a linear network. **6**

2. Give the construction and theory of ballistic galvanometer. **6**

3. a) State Faraday's laws of electro magnetic induction.

   b) Derive Maxwell's equation $\vec{\nabla} \times \vec{H} = \vec{J} + \frac{d\vec{D}}{dt}$. **(2+4)**

4. Derive an expression for velocity of electromagnetic wave in a dielectric medium and hence refractive index of the medium. **6**

5. a) Obtain an expression for the decay of current in a d.c. circuit containing an inductance and resistance and hence represent the decay graphically.

   b) Define the time constant of the circuit. **(5+1)**

6. Derive an expression for current in an LCR series circuit to which an ac voltage is applied by j-operator method. **6**

7. a) State the laws of thermo-electricity.

   b) Applying the principles of thermodynamics, arrive at the relation $\pi = T\frac{de}{dT}$ for a thermocouple. **(2+4)**

8. a) State and explain Kirchhoff's law of radiation.

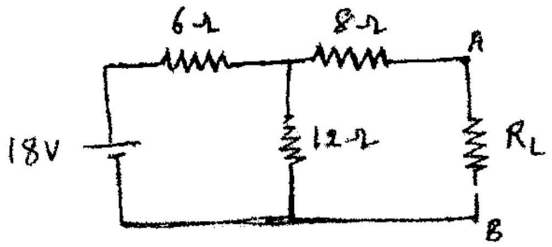
   b) Explain how solar constant can be determined using Angstrom's Pyreheliometer. **(2+4)**

P.T.O.

PART – B

Answer **any four** of the following questions. **Each** question carries **five** marks. **(4×5=20)**

9. For the circuit shown in the figure, find the value of R_L to be connected across the terminals A and B for maximum power transfer. Find the value of maximum power.



10. A Helmholtz galvanometer has coils of radius 0.077 m each and the number of turns $49\sqrt{5}$. Calculate the current through the coils which produces a deflection of 45°. What will be the deflection if the current is doubled ? Given $B_H = 0.32 \times 10^{-4}$ T and $\mu 0 = 4\pi \times 10^{-7}$ Hm^{-1}.

11. Calculate the Peak values of electric and magnetic fields in a microwave beam of power density 100 Wm^{-2} travelling in free space.

12. If a battery of emf 50 V is connected in series with inductor of 10 mH, capacitor 0.5 μF and resistor 250 Ω.
    i) Is the circuit oscillatory and
    ii) Find the frequency of the current if oscillatory.

13. A capacitor of 1000 μF and resistor of 50 Ω are connected in series to 220 V, 50 Hz ac mains. Calculate the value of current and phase of the current. What is the power dissipated in the circuit ?

14. For a Ag-Cu thermocouple with its junction at 0°C and 80°C, the seebeck co-efficients are $a = 13.31\ \mu v/c°$ and $b = -0.019\ \mu v/c°^2$. Calculate :
    i) Thermo-electric power and Peltier emf.
    ii) Neutral temperature and inversion temperature.

PART – C

Answer **any five** of the following questions. **Each** question carries **two** marks. **(5×2=10)**

15. a) A current carrying solenoid behaves as a bar magnet. Explain.

    b) Is eddy current produce sufficient heat in a metal ? Explain.

    c) Magnetic poles always appears as dipole. Justify on the basis of Maxwell's equations.

    d) Average value of an ac is taken over half cycle while rms value is taken over a complete cycle. Explain.

    e) Peltier effect is reversible whereas joule effect is irreversible. Justify.

    f) Which one of the Maxwell's equations confirms the existence of positive and negative charges ? Explain.

    g) An alternating current is passed through a thermocouple. What is the Peltier heat developed ?

    h) A cloudy night is hotter than a clear sky night. Why ?

22339

III Semester B.Sc. Examination, November/December 2013
(Semester Scheme)
PHYSICS – III (301)
Paper – III : Electricity, Magnetism and Radiation

Time : 3 Hours Max. Marks : 60

***Instruction** : Answers should be written **completely** in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **6** marks. **(5×6=30)**

1. State and prove Thevenin's theorem. **6**

2. With necessary theory, obtain an expression for the current through Helmholtz's double coil galvanometer. **6**

3. a) State Lenz's law of electro-magnetic induction.
   b) Derive the equation of continuity. **(1+5)**

4. a) Define Poynting vector.
   b) Show that energy is equally shared between electric and magnetic fields in the electro-magnetic wave. **(1+5)**

5. a) Obtain an expression for decay of current in C.R. circuit.
   b) Represent it graphically and define time-constant. **(4+2)**

6. Obtain an expression for current in a series L-R. circuit to which an a.c voltage is applied by j-operator method. **6**

7. a) Define neutral temperature and inversion temperature. Derive an expression for them.
   b) What is Thermo-electric power diagram ? Mention any two applications of Thermo-electric power diagram. **(4+2)**

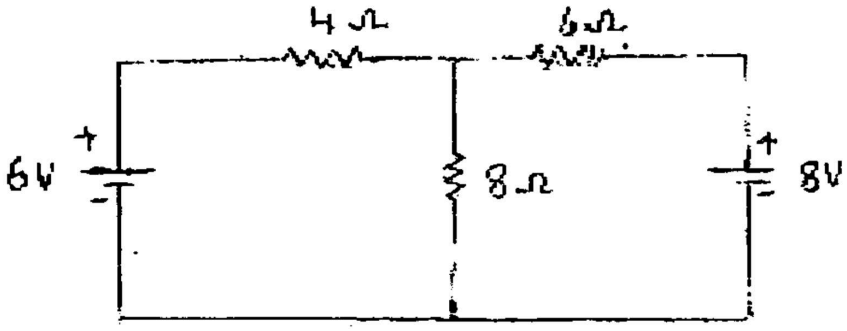
8. a) What is a perfectly black body ?
   b) Explain the distribution of energy in the spectrum of black body radiation. **(1+5)**

P.T.O.

PART – B

Answer any four of the following questions. Each question carries 5 marks. (4×5=20)

9. Find the current through 8Ω resistance using super-position theorem, in the circuit given below.



10. A capacitor charged to 2 volt is discharged through a Ballistic Galvanometer when the corrected deflection is 9.6 cm and the current sensitivity is 4.54 mm/μA, period is 12 seconds. Calculate the capacitance of the capacitor.

11. A plane electro-magnetic wave travelling along X-direction in an un-bounded loss less di-electric medium of $\mu_r = 2$ and $\in_r = 5$ has a peak electric field strength of 10 Vm^{-1}.

    Calculate :

    i) Velocity of the wave

    ii) Intrinsic impedance of the medium and

    iii) Peak value of magnetic field strength.

12. In a series L-C-R circuit the resonant frequency is 600 Hz. The half power points are obtained at frequencies 545 Hz and 655 Hz. If the capacitance value is 0.1 μf, find

    i) Quality factor

    ii) Band width and

    iii) Inductance of the coil.

13. The e.m.f. of a thermo-couple is 400μv, when the junctions are at 0°C and 50°C. Calculate the Seebeck co-efficient and the neutral temperature of the thermo-couple.

14. Calculate the black body temperature of the sun from the following data.

Stefans constant = 5.77×10^{-8} $Wm^{-2} K^{-4}$

Solar constant = 1400 Wm^{-2}

Radius of the sun = 7×10^{8} m

Distance between the sun and earth = 1.5×10^{11} m.

PART – C

Answer **any five** of the following questions. **Each** question carries **2** marks. **(5x2=10)**

15. a) Can the efficiency of a power source be 100% ? Justify your answer.
    b) A current loop behaves as a magnetic dipole. Explain.
    c) Is it possible to have a pure electric wave in space ? Explain.
    d) Refractive index of any di-electric medium is always greater than 1. Explain.
    e) Why a.c. voltage is always measured in terms of r.m.s. values ?
    f) Does time constant of a C-R circuit depends on the applied e.m.f. ? Explain.
    g) Distinguish between Peltier effect and Joule effect.
    h) Can the earth without its atmosphere be very cold ? Explain.

Q.P. Code – 42341

Third Semester B.Sc. Degree Examination, November 2017

(CBCS Scheme – 2016 onwards)

Physics

Paper III – THERMODYNAMICS, LOW TEMPERATURE PHYSICS, RADIATION AND OPTICS

Time : 3 Hours] *[Max. Marks : 90*

Instructions to Candidates : Answers should be written completely in English.

PART – A

Answer any **FIVE** of the following questions. Each question carries **8** marks.

(5 × 8 = 40)

1. What is mean free path? Derive the expression for mean free path of gas molecule. Mention Maxwell correction for mean free path. **(8)**

2. What is transport phenomena? Derive the expression for thermal conductivity due to transport of heat molecules. **(8)**

3. Explain First law of thermodynamics. Apply mathematical formulation of first law of thermodynamics to different thermodynamic process. **(8)**

4. Derive Clausius-Clapeyron's equation for ideal gas from Maxwell's thermodynamic relations. How does melting point and boiling point vary with pressure? **(8)**

5. Explain with a neat labelled diagram, the principle, construction and working of diffusion pump. **(8)**

6. (a) Define the terms emissive power and absorptive power.

   (b) State and prove Kirchhoff's law of radiation. **(2 + 6)**

7. What is Fresnel's Biprism? Give theory of Fresnel's Biprism. **(8)**

8. Explain with a neat labeled diagram, the construction and working of Michelson's Interferometer to determine wavelength of light. **(8)**

PART – B

Answer any **SIX** from the following. Each question carries **5** marks : **(6 × 5 = 30)**

9. Calculate average velocity of CO_2 gas molecule at NTP.

   Boltzmann constant $= 1.38 \times 10^{-23}\ JK^{-1}$

   Avogadro's number $= 6.023 \times 10^{23}$ atoms per mole.

10. Root mean square velocity of oxygen gas molecule is 1842 m/s. If diameter of oxygen molecule is 2.6×10^{-10} m, calculate coefficient of viscosity of oxygen gas molecules. Avogadro's number $= 6.023 \times 10^{23}$ atoms per mole.

11. Calculate the efficiency of hydrogen gas fueled Otto engine if adiabatic compression ratio is 6. ($\gamma = 1.4$)

12. A Carnot heat engine operating between source at temperature 500 K and sink at temperature 400 K. If heat engine absorbs 200 Joule of heat from the source. Calculate the amount of heat rejected to the sink.

13. Calculate the Joule-Thomson coefficient for Nitrogen at 0°C from the following data. $C_p = 30\ Jmol^{-1}$, $a = 0.13\ Nm^4\ mol^{-2}$, $b = 3.1 \times 10^{-5}\ m^3\ mol^{-1}$, $R = 8.314\ JK^{-1}mol^{-1}$

14. Calculate the amount of energy emitted per second per unit area of perfectly black body maintained at (a) 600 K (b) 700 K.

15. In Young's double slit interference experiment, the slits separation is doubled and the distance between the slit and the screen is halved. Calculate new fringe width. What happens to new fringe width?

16. Newton's rings arrangement is used with a source emitting two wavelengths λ_1 and λ_2. It is found that the m^{th} dark ring due to λ_1 coincides with $(m+1)^{th}$ dark ring due to λ_2. Find the diameter of the m^{th} dark ring due to λ_1. Given $\lambda_1 = 6200\,Å$ and $\lambda_2 = 6000\,Å$ and radius of curvature of the lens is 1.2 m.

PART – C

Answer any **TEN** from the following. Each question carries **2** marks : **(10 × 2 = 20)**

17. (a) Does viscosity of gas depend on temperature? Explain.

    (b) Does coefficient of diffusion depend on pressure? Explain.

    (c) What are the conditions at which ideal gas equation can be applied to real gas? Explain.

(d) The entropy of the universe is always increasing. Explain.

(e) Among Otto engine and Diesel engine, which one has higher efficiency at given conditions? Explain.

(f) Efficiency of Carnot heat engine cannot be greater than unity. Explain.

(g) Name the thermodynamic process during which (i) internal energy (ii) enthalpy remains constant.

(h) Can a gas be liquefied just by applying high pressure above its inversion temperature? Explain.

(i) Can Mercury is used in diffusion pump? Explain.

(j) Why animals curl their body in winter season? Explain.

(k) Give two examples for interference of light that can be observed in daily life.

(l) What happens to the fringe width if red light is replaced by violet light? Explain.

Q.P. Code – 22339

Third Semester B.Sc. Degree Examination, November 2017

(Old – Semester Scheme)

(Non-CBCS – Repeaters)

Physics

Paper 301 – ELECTRICITY, MAGNETISM, RADIATION AND THERMO ELECTRICITY

Time : 3 Hours] *[Max. Marks : 60*

Instructions to Candidates : Answers should be written completely in English.

PART – A

Answer any **FIVE** of the following questions. Each question carries **6** marks. **(5 × 6 = 30)**

1. State and prove maximum power transfer theorem. **(6)**

2. Obtain an expression for the magnetic field at a point on the axis of a long solenoid. **(6)**

3. (a) State Faraday's Laws of electromagnetic induction.

   (b) Obtain an expression for magnetic field on the axis of circular coil. **(2 + 4)**

4. Derive an expression for velocity of electromagnetic wave in a dielectric medium and hence refractive index of the medium. **(6)**

5. Obtain an expression for growth of current in a series L-R circuit. **(6)**

6. Obtain an expression for the current in an AC circuit containing capacitor and resistor. **(6)**

7. (a) Define laws of thermo-electricity.

   (b) Give an experimental demonstration of Peltier effect. **(2 + 4)**

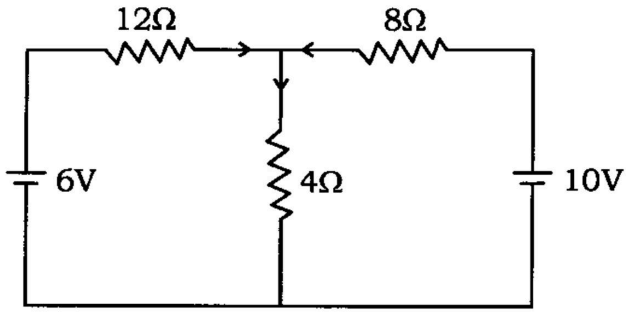
8. State and prove Kirchoff's law of radiation. **(6)**

PART – B

Answer any **FOUR** of the following questions. Each question carries **5** marks.

(4 × 5 = 20)

9. Using Superposition theorem, find the current in each branch of the network.



10. A condenser of capacity 0.2 μF is charged to 3 volts, when discharged through a B.G. it gives a deflection of 10 cm. Calculate the current sensitivity of galvanometer, if its periodic time is 10 seconds.

11. Calculate the magnitude of the Poynting vector at the surface of the Sun. Determine the average solar energy incident on the earth, when the Sun radiates 3.8×10^{26} W. Given radius of the Sun is 7×10^{8} m and the distance between the earth and the Sun is 1.5×10^{11} m.

12. A 48 ohm resistor is connected in series with an inductance of 450 mH and a capacitance of 9 micro farad.

    (a) What is the resonant frequency?

    (b) What will be the current in a circuit when it is supplied from a 120 V source operating at resonant frequency?

    (c) What is the voltage across the inductance under these conditions?

13. The emf of a thermocouple is 400 μV when the junctions are at 0°C and 50°C. It is 500 μV in the same direction when the junctions are at 0°C and 100°C. Calculate the Seebeck co-efficients and the neutral temperature of the thermocouple.

14. Estimate the surface temperature of the Sun using the following data :

    Mean distance of the Sun from the earth = 1.484×10^{8} Km

    Stefan's constant = 5.665×10^{-8} $Wm^{-1}K^{-4}$

    Solar constant = 1.36×10^{3} Wm^{-2}

    Radius of the Sun = 7×10^{5} Km.

PART – C

Answer any **FIVE** of the following questions. Each question carries **2** marks.

(5 × 2 = 10)

15. (a) The coil of B.G. stops oscillating when it is short circuited. Explain.

(b) If you double the speed of the charged particle keeping the magnetic field same, how does this affect the radius of the trajectory and the time for one complete circular orbit?

(c) Is the velocity of the particle can be greater than the velocity of light in free space? Explain.

(d) How is energy shared between electric field and magnetic field in an electromagnetic wave? Explain.

(e) A series resonance circuit is called accepter circuit. Comment.

(f) Why AC voltage is always measured as rms values?

(g) Distinguish between Peltier effect and Thomson effect.

(h) Is white cloths are preferred in summer? Explain.

22339

III Semester B.Sc. Examination, October/November 2012
(Semester Scheme)
PHYSICS (301)
Paper – III : Electricity, Magnetism and Radiation

Time : 3 Hours Max. Marks : 60

***Instruction** : Answers should be written **completely** in **English**.*

PART – A

Answer **any five** of the following questions. **Each** question carries **6** mark. **(5x6=30)**

1. a) State and prove maximum power transfer theorem.
   b) Give an application of this theorem. **(5+1)**

2. a) Obtain the expression for the charge sensitivity of a ballististic galvanometer with necessary diagram.
   b) Arrive at the exact expression for deflection by applying damping correction. **(4+2)**

3. a) State Faraday's laws of electromagnetic induction.
   b) Derive the relation, $e = \frac{-d\phi}{dt}$. **(2+4)**

4. a) Give four important characteristics of displacement current.
   b) Derive the equation of continuity. **(2+4)**

5. a) Derive an expression for growth of current in an L-R circuit with a d.c. source.
   b) Represent it graphically.
   c) Define the time constant of an L-R circuit. **(4+1+1)**

6. Obtain the expression for current in an LCR circuit with a.c. source by j-operator method. **6**

P.T.O.

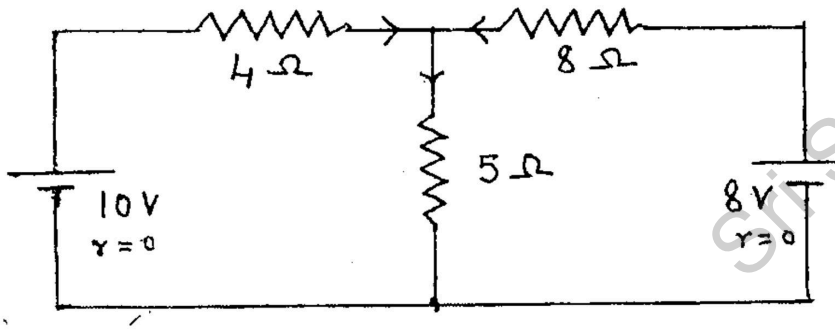
7. a) Define Thermo-electric power.
   b) Show that peltier co-efficient is equal to the product of absolute temperature and thermoelectric power. **(1+5)**

8. a) State and prove Kirchoff's law for radiation.
   b) Explain the working of Angstrom's pyrheliometer with the help of a neat diagram. **(3+3)**

PART – B

Answer **any four** of the following questions. **Each** question carries **5** marks. **(4×5=20)**

9. In the circuit given below, find the current through the 5 ohm resistor using superposition theorem.



10. Calculate the strength of magnetic field on the axis of a solenoid of length 2m, diameter, 0.05 m with 2000 turns at : i) the centre, ii) one of its ends, when a current of 5 A is passed through it.

11. The average power radiated by a broadcasting station is 6 kW. Assuming the power to be radiated over the surface of the hemisphere of radius 12 km with the station at its centre, calculate :
    i) The magnitude of the pointing vector on the surface of the hemisphere, and
    ii) Maximum electric intensity at points on the surface of the hemisphere.

12. A condenser of capacity 0.01 μ F is discharged through an inductance of 10 mH and a resistance of 1000 ohm. Calculate the frequency of oscillation. What is the additional resistance that should be included in the circuit so that the oscillation may just stop ?

13. Calculate the Neutral temperature, temperature of inversion and thermo-e.m.f. of a thermocouple between 0 and 100°C for which Seebeck co-efficients are :

    a = – 13.89 micro volt/°C and

    b = 0.026 micro volt/° C^2.

14. A blackened metal sphere of radius 7 cm is enclosed in an evacuated chamber maintained at a temperature of 27°C. At what rate, energy must be supplied to the sphere so as to keep the temperature constant at 127°C.

    Given $\sigma = 5.7 \times 10^{-8}\ Wm^{-2}\ K^{-4}$.

PART – C

Answer **any five** of the following questions. **Each** question carries **2** marks. **(5×2=10)**

15. a) Can we apply superposition theorem to power as we apply to voltage or current in a network. Justify.

    b) The current in two coils of a Helmnoltz Galvanometer should be in the same direction. Why ?

    c) What will happen, if a cell is connected in the circuit that sends current in the direction opposite to that due to Seebeck effect.

    d) Why magnetic poles always appear as dipoles ?

    e) A parallel resonance circuit is called as a rejector and a series resonance circuit as an acceptor circuit. Why ?

    f) Why a.c. voltage is always measured as r.m.s. values ?

    g) Is it true that a clear sky night is cooler than a cloud covered night ? Justify.

    h) What is the difference in surface temperature of sun estimated from total radiation law and Wein's displacement law ? Give reason.