Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College *(As Per Ordinance 14-A)*
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *w.e.f* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MJS-175
2.	Course Title	**Core- Semiconductor Devices**
3.	Course Type (Major /Minor/ Discipline Specific Elective / Generic Elective)	**Major**
4.	Pre-Requisite (if any)	**10 + 2 with Mathematics Group**
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • describe the behaviour of semiconductor materials • reproduce the I-V characteristics of diode/BJT/MOSFET devices • apply standard device models to explain/calculate critical internal parameters of semiconductor devices • explain the behaviour and characteristics of power devices such as SCR/UJT etc.
6.	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Lectures (in hours per week): **L – 4 Hours**
Total No. of Lectures: **L – 60**

Module	**Topics**	**No. of Lectures**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

I	**Semiconductor Basics:** Introduction to Semiconductor Materials, Crystal Structure, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **Carrier Transport Phenomena:** Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Continuity Equation. ***Keywords:*** *Semiconductor materials, Fermi Level, drift velocity.*	**14**
II	**P-N Junction Diode:** Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Zener Diode, Tunnel diode, varactor diode, LED: circuit symbol, characteristics, applications ***Keywords:*** *PN Junction Diode, Depletion Layer, Zener Diode, LED*	**14**
III	**Bipolar Junction Transistors (BJT):** PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. ***Keywords:*** *Bipolar Junction Transistor, Majority and Minority Carriers.*	**14**
IV	**Field Effect Transistors & Power Devices:** JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). **UJT:** Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. **SCR:** Construction, Working and Characteristics, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications. ***Keywords:*** *MOSFET, UJT, DIAC.*	**18**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. Electronic Circuits: Discrete &Integrated; Boylestad & Neshelsky, PHI. 2. A Text Book of Applied Electronics – R.S.Sedha, S. Chand & Company Ltd. **Reference Book**: 3. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002). 4. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006) 5. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001) 6. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
7. ***Suggestive digital platform web links***
1. https://en.wikipedia.org/wiki/Semiconductor_device 2. https://www.electronics-tutorials.ws/diode/diode_1.html
Suggested equivalent online courses
MIT open course ware, MIT Course Number 6.012https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **UG Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *w.e.f* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MJS-175
2.	Course Title	**Core- Semiconductor Devices – Lab**
3.	Course Type (Major /Minor/ Discipline Specific Elective / Generic Elective)	**Major**
4.	Pre-Requisite (if any)	**10 + 2 with Mathematics Group**
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Examine the characteristics of basic semiconductor devices. • Perform experiments for studying the behaviour of semiconductor devices for circuit design applications. • Calculate various device parameters' values from their IV characteristics. • Interpret the experimental data for better understanding the device behavior.

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

6.	Credit Value	**2 (P)**
PART-B: **CONTENT OF THE COURSE**		
Total No. of Practical (in hours per week): **P – 4 Hours**		

Suggestive List of Practical to be performed inSemiconductor Devices Lab

1. Study of Band Gap in a Junction Diode.
2. Study of Zener Regulated Power Supply.
3. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
4. Study of the I-V Characteristics of the CE configuration of BJT and obtain β.
5. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain α.
6. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain.
7. Study of the I-V Characteristics of the UJT.
8. Study of the I-V Characteristics of the SCR.
9. Study of the I-V Characteristics of JFET.
10. Study of the I-V Characteristics of MOSFET.
11. Study of Characteristics of Diac.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002). 2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
Suggestive digital platform web links
http://vlabs.iitkgp.ac.in/be/#
Suggested equivalent online courses

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics and Electronics
(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Physics**			

1	Course Code	MNS-172
2	Course Title	**Mechanics**
3	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Minor**
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or general elective subject in B.Sc. I sem.
5	Course Learning Outcomes (CLO)	The course would empower the student to develop the idea about the behavior of physical bodies. It will provide the basic concepts related to the motion of all the object around us in daily life. The students would be able to build foundation to various applied field in science and technology especially in the field of mechanical engineering. The student will acquire the knowledge of basic mathematical methods to solve the various problems in physics. The students will be able the understand the relativistic effect and the relation energy and mass.
6	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4 Hrs**

Total No. of Lectures: **L – 60**

Module	**Topics**	**No. of Lectures**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

I	**Historical background:** A brief historical background of mathematics and mechanics in the context of India and Indian culture. A brief biography of Varahamihira and Vikram Sarabhai With their major contribution to science and society. **Fundamentals of Dynamics:** Reference frames, Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. *Momentum of variable-mass system:* motion of rocket. System of particles. Centre of Mass. Principle of conservation of momentum. Impulse. *Work and energy:* Work and Kinetic Energy Theorem. Conservative and non conservative forces. Potential Energy. Energy diagram. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by non conservative forces. Elastic and inelastic collisions between particles. Centre of Mass. ***Keywords:*** *Kinetic energy, Galilean transformations, Center of mass.*	15
II	**Rotational Dynamics:** Angular momentum of a particle and system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia; Calculation of moment of inertia for rectangular, cylindrical and spherical bodies; Kinetic energy of rotation. **Elasticity:** Relation between Elastic constants, Twisting torque on a Cylinder or Wire. **Fluid Motion:** *Kinematics of Moving Fluids:* Poiseuille's Equation for Flow of a liquid through a Capillary Tube. ***Keywords:*** *Angular momentum, Inertia, Fluid*	15
III	**Gravitation and Central Force Motion:** Law of gravitation, Gravitational potential energy, Potential and field due to spherical shell and solid sphere; Motion of a particle under a central force field; Two-body problem and its reduction to one-body problem and its solution; The energy equation and energy diagram; Kepler's Laws, Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness. **Oscillations:** *SHM:* Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. *Forced oscillations:* Transient and steady states; Resonance, sharpness of resonance; Power dissipation and Quality factor. ***Keywords:*** *SHM, Gravitation, Oscillation, Quality factor.*	15

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

IV	**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cartesian Coordinate system. **Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. ***Keywords:*** *Centrifugal force, Relativity, Lorentz Transformations, Lorentz contraction, Time dilation.*	15

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1.Mechanics, D.S. Mathur, S. Chand and Company

Reference Book:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.-1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday, 2005, Cengage Learning
5. Feynman Lectures, Vol.-I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Suggestive digital platform web links

https://en.wikipedia.org/wiki/Galilean_transformation

https://en.wikipedia.org/wiki/Mechanics

https://link.springer.com/chapter/10.1007/978-3-030-15195-9_9

https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004261258145148brijesh_engg_Elastic_Constants.pdfhttps://en.wikipedia.org/wiki/Special_relativity

Suggested equivalent online courses

NPTEL Courses: NA

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics and Electronics

(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Physics**			

1	Course Code	MNS-172
2	Course Title	**Mechanics Lab**
3	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Minor**
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or general elective subject in B.Sc. I sem.
5	Course Learning Outcomes (CLO)	The course would empower the student to develop the idea about the behavior of physical bodies. It will provide the basic concepts related to the motion of all the object around us in daily life. The students would be able to build foundation to various applied field in science and technology especially in the field of mechanical engineering. The student will acquire the knowledge of basic mathematical methods to solve the various problems in physics. The students will be able the understand the relativistic effect and the relation energy and mass.
	Credit Value	**4 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 2Hr**

Suggestive list of experiments:

1. Measurements of length (or diameter) using Vernier-Calipers, Screw-Gauge & Travelling Microscope.
2. To study the error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) '**g'** and (c) Modulus of rigidity.

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

5. To determine the Moment of Inertia of a Flywheel.
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a wire by Maxwell's Needle.
9. To determine the Elastic constants of a wire by Searle's method.
10. To determine the value of '***g***' using Bar Pendulum.
11. To determine the value of '***g***' using Kater's Pendulum.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: *Practical Physics for BSc first Year, Dr. B.K. Sinha, Ram Prasad and Sons.*
Reference Books: 1. Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House 2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, KitabMahal 4.Engineering Practical Physics, S. Panigrahi & B. Mallick,2015, Cengage Learning India Pvt. Ltd. 4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
Suggestive digital platform web links:
https://en.wikipedia.org/wiki/Sextanthttps://en.wikipedia.org/wiki/Calipers https://www.brainkart.com/article/Determination-of-coefficient-of-viscosity-of-water-by-Poiseuille-s-flowmethod_3059/https://universe.bits-pilani.ac.in/uploads/Pilani/navin/ReadPDFDOC/YM.pdfhttps://dkpandey.weebly.com/uploads/1/3/5/3/13534845/maxwell_needle.pdfhttps://www.concepts-of-physics.com/searle-method/searle-method.php https://gfgc.kar.nic.in/davanagere-women/GenericDocHandler/166-a27e1694-5dcb-42cf-8939c5e07033108b.pdf https://en.wikipedia.org/wiki/Kater%27s_pendulum
Suggested equivalent online courses:
NPTEL Courses: NA

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College *(As Per Ordinance 14-A)*
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MJS-275
2.	Course Title	**Basic Circuit Theory and Network Analysis**
3.	Course Type (Major / Minor/ Discipline Specific Elective / Generic Elective)	**Major**
4.	Pre-Requisite (if any)	**10+2 with Mathematics Group**
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Study circuits in a systematic manner suitable for analysis and design. • Formulate circuit analysis problems in a mathematically tractable way with an emphasis on solving linear systems of equations. • Analyses the electric circuit using network theorems. • Determine Sinusoidal steady state response. • Find out two-port network parameters & overall response for its interconnection.
6.	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures + Practical (in hours per week): **L – 4 Hours**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Basic Circuit Concepts:** Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color-coding of resistors, resistors in series and parallel. **Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, testing of resistance and inductance-using multimeter. **Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors,	**13**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

	testing of capacitors using multimeter. ***Keywords:*** *Mutual inductance, permittivity, electromagnetic induction, dielectric constant.*	
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. ***Keywords:*** *Node analysis, mesh analysis, time constant*	**13**
III	**AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance. **Power in AC Circuits:** Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. **Passive Filters:** Low Pass, High Pass, Band Pass and Band Stop. ***Keywords:*** *Root Mean Square and Average Values, Complex Impedance, Quality Factor, Bandwidth*	**18**
IV	**Network Theorems:** Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. ***Keywords:*** *Impedance, Admittance & Transmission Parameters.*	**16**

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. S. Salivahanan, S. Pravin Kumar, Circuit Theory, Vikas Publishing House Pvt. Ltd. 2014. 2. John D. Rider, Networks, line and fields, PHI Second Edition 1989. 3. G. K. Mithal, Network Analysis, Khanna Publication, 4th Edition, 1997.
1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004) 2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw Hill. (2005) 3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004) 4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005) 5. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

Suggestive digital platform web links

1. Lectures: https://ocw.mit.edu/index.htm)
2. Videos: https://www.youtube.com/c/mitocw/search?query=circuit%20theory
3. https://en.wikipedia.org/wiki/Network_analysis_(electrical_circuits)
4. https://en.wikipedia.org/wiki/Th%C3%A9venin%27s_theorem
5. https://en.wikipedia.org/wiki/Superposition_theorem

Suggested equivalent online courses.

1. https://www.coursera.org/
2. NPTEL E-Learning Courses

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MJS-275
2.	Course Title	**Basic Circuit Theory and Network Analysis Lab**
3.	Course Type (Major / Minor/ Discipline Specific Elective / Generic Elective)	**Major**
4.	Pre-Requisite (if any)	**10+2 with Mathematics Group**
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Verify the network theorems and operation of typical electrical and electronic circuits. • Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits. • Prepare the technical report on the experiments carried.
6.	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hours**

Suggestive List of Practical to be performed inNetwork Analysis Laboratory

1. Familiarization with
   a) Resistance in series, parallel and series – Parallel.
   b) Capacitors & Inductors in series & Parallel.
   c) Multimeter – Checking of components.
   d) Voltage sources in series, parallel and series – Parallel
   e) Voltage and Current dividers
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

5. Verification of Thevenin's Theorem.
6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a)Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width

PART-C: **LEARNING RSOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1.S. P. Chandra Rao, Electronics Laboratory Primer, S. Chand Company Pvt. Ltd.
Suggestive digital platform web links
1.http://vlabs.iitb.ac.in/vlabs-dev/labs/network_lab/labs/explist.php
Suggested equivalent online courses
SWAYAM Course: **……**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics
(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Physics**			

1	Course Code	GES-171
2	Course Title	**Mechanics**
3	Course Type (Major /Minor Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-I** (Theory)
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{tl} class and should not have taken physics as a either major or minor subject.
5	Course Learning Outcomes (CLO)	After completing this course student will be able to: • understand fundamental laws of mechanics, • understand differentiation, • understand vector quantities, • understand work energy relation, •understand rotational motion, elasticity, • understand oscillations and relativity.
6	Credit Value	**3 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 3Hrs**

Total No. of Lectures: **L – 45**

Module	Topics	No. of Lectures
I	**Vectors:** Vector algebra. Scalar and vector products. Differentiation of a vector. **Ordinary Differential Equations:** First, order homogeneous differential equations. Second order homogeneous differential equations with constant coefficients. **Laws of Motion:** Frames of reference. Newton's Laws of motion. Dynamics of a system of particles. Centre of Mass. ***Keywords:*** *Vector, Newtons Laws, Center of Mass.*	12

Date of BOS: …… Signature of the Chairmen (BOS):
Subject: …… Name: ……

II	**Rotational Motion:** Angular velocity and angular momentum. Torque. Conservation of angular momentum. **Gravitation:** Newton's Law of Gravitation, Motion of a particle in a central force field, Kepler's Laws (statement only), Satellite in circular orbit and applications, Weightlessness. ***Keywords:*** *Angular momentum, Laws of Gravitation, Kepler's Laws*	11
III	**Oscillations:** Simple harmonic motion. Differential equation of SHM and its solutions. Kinetic and Potential Energy, Total Energy and their time averages. Damped oscillations. **Elasticity:** Hooke's law, Stress-strain diagram, Elastic moduli, Relation between elastic constants, Work done in stretching and work done in twisting a wire, Twisting couple on a cylinder, Determination of Rigidity modulus by static torsion, Torsional pendulum, Determination of elastic constants by Searle's method. ***Keywords:*** *Harmonic Motion, SHM, Elasticity, Hooke's law, Torsional pendulum.*	14
IV	**Special Theory of Relativity:** Constancy of speed of light. Postulates of Special Theory of Relativity. Lorentz transformation, Length contraction. Time dilation. Relativistic addition of velocities. ***Keywords:*** *Speed of light, Lorentz transformation, Length contraction. Time dilation.*	08

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1.Mechanics, D.S. Mathur, S. Chand and Company **Reference Book**:

1. An introduction to Mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday. 2005, Cengage Learning
5. Feynman Lectures, Vol. I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Suggestive digital platform web links

https://en.wikipedia.org/wiki/Galilean_transformationhttps://en.wikipedia.org/wiki/Mechanics
https://link.springer.com/chapter/10.1007/978-3-030-15195-9_9
https://www.lkouniv.ac.in/site/writereaddata/siteContent/202004261258145148brijesh_engg_Elastic_Constants.pdfhttps://en.wikipedia.org/

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics and Electronics

(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **UG Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Physics**			
1	Course Code	GES-171	
2	Course Title	**Mechanics Lab**	
3	Course Type (Major /Minor Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-I** (Practical)	
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or minor subject.	
5	Course Learning Outcomes (CLO)	After completing this course student will be able to: • understand measurement using Vernier-Calipers, Screw-gauge, • understand measurement using Sextant, • understand measurement of gravitational acceleration, • understand measurement of constant of rigidity, • understand measurement of moment of inertia, • understand measurement of elastic constants, • understand measurement of constant of viscosity.	
6	Credit Value	**1 (P)**	

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 2Hr**

1. Measurements of length (or diameter) using Vernier-Calipers, screw gauge and travelling microscope.
2. To study the error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.
6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a wire by Optical Lever Method.

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Subject: …… Name: ……

8. To determine the Modulus of Rigidity of a Wire by Maxwell's needle.
9. To determine the elastic Constants of a wire by Searle's method.
10. To determine the value of g using Bar Pendulum.
11. To determine the value of g using Kater's Pendulum.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: • Practical Physics for BSc First Year, Dr. B.K. Sinha, Ram Prasad and Sons.
Reference Books: 1. Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House 2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heineman 3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11thEdn, 2011, Kitab Mahal Engineering Practi Cengage Learning India Pvt. Ltd. 4. Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
Suggestive digital platform web links
https://en.wikipedia.org/wiki/Sextanthttps://en.wikipedia.org/wiki/Calipershttps://www.brainkart.com/article/Deter water-by-Poiseuille-sflow-method_3059/https://universe.bits-pilani.ac.in/uploads/Pilani/navin/ReadPDFDOC/YM.pdfhttps://dkpandey.weebly.com/uploads/1/3/5/3/13534845/ of-physics.com/searle-method/searle-method.phphttps://gfgc.kar.nic.in/davanagere-women/GenericDocHandler 8939c5e07033108b.pdfhttps://en.wikipedia.org/wiki/Kater%27s_pendulum
Suggested equivalent online courses: *NA*

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College *(As Per Ordinance 14-A)*

Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Electronic Science**			

1.	Course Code	GES-175
2.	Course Title	**Electric Circuits and PCB designing using TINA**
3.	Course Type (Major/Minor/ / Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-I (Theory)**
4.	Pre-Requisite (if any)	Open to all except the students of Electronics as either major or minor subject.
5.	Course Learning Outcomes (CLO)	**After completing this course student will be able to:** • Study circuits in a systematic manner suitable for analysis and design. • Describe the behaviour of semiconductor materials. • Reproduce the I-V characteristics of P-N junction Diodes. • Infer the characteristics of operational amplifiers and its effect on output and their compensation techniques. • Explain and compare the working of general-purpose applications of op-amp. • familiarize with the type of devices/components that may be mounted on PCB • Familiarize with TINA (**Toolkit for Interactive Network Analysis**) Software and effectively use it for circuit designing and simulations. • Understand the PCB layout techniques for optimized component density and power saving. • Design and printing of PCB with the help of various image transfer and soldering techniques.
6.	Credit Value	**3 (L)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Lectures (in hours per week): **L – 3 Hours**
Total No. of Lectures: **L – 45**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Module	Topics	No. of Lectures
I	**Basic Circuit Concepts**: Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color coding of resistors, resistors in series and parallel. Testing of resistance using multimeter. **Inductors:** Fixed and Variable inductors, Self and mutual inductance, Energy stored in an inductor, Inductance in series and parallel, testing of inductance using multimeter. **Capacitors:** Principles of capacitance, Parallel plate capacitor, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, capacitors in series and parallel, testing of capacitors using multimeter. ***Keywords:*** *Resistance, Capacitance, Inductance, Multimeter.*	**09**
II	**Semiconductors:** Introduction, Intrinsic & Extrinsic Semiconductors, Bang Gap energy and its significance, P-N Junction Diode: its characteristics, Biasing (forward & reverse), applications. Types of Diodes: Zener diode, Tunnel Diode, LED, Photodiode. **Rectifiers:** Half wave Rectifier, Full Wave rectifier. ***Keywords:*** *Band -Gap, P-N Junction, Diodes, LED, Photodiode.*	**10**
III	**Basic Operational Amplifier & Op-Amp Circuits:** Concept of differential amplifiers (Dual input balanced and unbalanced output), constant current bias, current mirror, cascaded differential amplifier stages with concept of level translator, block diagram of an operational amplifier (IC 741). **Op-Amp Circuits:** Open and closed loop configuration, Inverting, Noninverting, Summing and difference amplifier, Integrator, Differentiator, Voltage to current converter, Current to voltage converter. ***Keywords:*** *Op-amp, Inverting & Non-inverting amplifier, Integrator, Differentiator.*	**10**
IV	**Introduction to TINA:** History of Toolkit for Interactive Network Analysis (TINA) software, features of TINA utilities, process of circuit designing using existing components, importing components from different packages and libraries, Circuit simulation. **Printed Circuit Board (PCB):** PCB Advantages, components of PCB, Electronic components, IC's, Surface Mount Devices (SMD), Manufacturing of PCB, PCB standards. **Technology OF PCB:** Design Rule Checking: Footprints and Libraries Adding and Editing, soldering techniques. Film master preparation, Image transfer, photo printing, Screen Printing, etching techniques, Soldering Techniques, Testing and quality controls. ***Keywords:*** *TINA (*Toolkit for Interactive Network Analysis*)*, PCB.	**16**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. Electronic Circuits: Discrete &Integrated; Boylestad & Neshelsky, PHI. 2. A Text Book of Applied Electronics – R.S. Sedha, S. Chand & Company Ltd. 3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004) 4. R. A. Gayakwad, Op-Amps and Linear IC's, Pearson Education (2003) **Reference Books:** 1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002). 2. J. Millman and C.C. Halkias, Integrated Electronics, Tata McGraw-Hill,(2001) 3. A.P.Malvino, Electronic Principals,6th Edition , Tata McGraw-Hill,(2003) 4.https://www.tina.com/
Suggestive digital platform web links
1. https://www.tutorialspoint.com/digital_communication/digital_communication_analog_to_digital.htm 2. https://www.tutorialspoint.com/analog_communication/index.htm 3. https://www.tutorialspoint.com/digital_communication/index.htm4.https://www.tina.com/
Suggested equivalent online courses
MIT open course ware, MIT Course Number 6.012https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6012-microelectronic-devices-and-circuits-fall-2009/

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics

(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **UGCertificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Electronic Science**			
1.	Course Code	GES-175	
2.	Course Title	**Electric Circuits and PCB designing using TINA**	
3.	Course Type (Major/Minor/ / Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-I (Practical)**	
4.	Pre-Requisite (if any)	Open to all except the students of Electronics as either major or minor subject.	
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Proficiency in Algorithm and Flow chart of the given assembly language program. • How to make assembly language program using microprocessor 8085 Kit and also by the simulator. • Able to know about the syntax used for mnemonics, operand and opcodes. • Able to use Instruction codes. • Debugging of Program	
6.	Credit Value	**1 (P)**	

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 2 Hours**

Suggestive List of Practical to be performed in Electric Circuits and PCBdesigning using TINA

1. Measurement of Resistance with the help of color coding.
2. Measurement of Resistance using Multimeter.
3. Measurement of Voltage and current for a given electrical circuit using Multimeter.
4. Study of Op-amp as Inverting amplifier.
5. Study of Op-amp as non-Inverting amplifier.
6. Study and plot V-I characteristics of P-N junction diode.
7. Study and plot V-I characteristics of Zener Diode.

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Subject: …… Name: ……

Suggestive List of Projects to be performed in Electric Circuits and PCBdesigning using TINA (any 1)

1. Design and Fabrication of Integrator using Op-amp.
2. Design and Fabrication of Differentiator using Op-amp.
3. Design and Fabrication of Summing amplifier using Op-amp.
4. Design and Fabrication of Subtractor using Op-amp.
5. Design and Fabrication of High-Pass Filter using Op-amp.
6. Design and Fabrication of Low-Pass Filter using Op-amp.
7. Design and Fabrication of Half Adder/Full adder.
8. Design and Fabrication of Half Subtractor/Full Subtractor.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks:
Suggestive digital platform web links
1. http://vlabs.iitkgp.ac.in/be/# 2. https://www.ti.com/tool/TINA-TI 3. https://www.tina.com/
Suggested equivalent online courses
NIL

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College *(As Per Ordinance 14-A)*
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MNS-176
2.	Course Title	**Basic Circuit Theory and Network Analysis**
3.	Course Type (Major / Minor/ Discipline Specific Elective / Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have mathematics group in 12thclass and should not have taken Electronics as a either major or general elective subject in B.Sc. I sem.
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Study circuits in a systematic manner suitable for analysis and design. • Formulate circuit analysis problems in a mathematically tractable way with an emphasis on solving linear systems of equations. • Analyses the electric circuit using network theorems. • Determine Sinusoidal steady state response. • Find out two-port network parameters & overall response for its interconnection.
6.	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4 Hours**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Basic Circuit Concepts:** Voltage and Current Sources, Resistors: Fixed and Variable resistors, Construction and Characteristics, Color-coding of resistors, resistors in series and parallel. **Inductors:** Fixed and Variable inductors, Self and mutual inductance, Faraday's law and Lenz's law of electromagnetic induction, Energy stored in an inductor, Inductance in series and parallel, testing of resistance and inductance-using multimeter. **Capacitors:** Principles of capacitance, Parallel plate capacitor, Permittivity, Definition of Dielectric Constant, Dielectric strength, Energy stored in a capacitor, Air, Paper, Mica, Teflon, Ceramic, Plastic and Electrolytic capacitor, Construction and application, capacitors in series and parallel, factors governing the value of capacitors,	**13**

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Subject: Electronics Name: ……

	testing of capacitors using multimeter. ***Keywords:*** *Mutual inductance, permittivity, electromagnetic induction, dielectric constant.*	
II	**Circuit Analysis:** Kirchhoff's Current Law (KCL), Kirchhoff's Voltage Law (KVL), Node Analysis, Mesh Analysis, Star-Delta Conversion. **DC Transient Analysis:** RC Circuit- Charging and discharging with initial charge, RL Circuit with Initial Current, Time Constant, RL and RC Circuits with Sources, DC Response of Series RLC Circuits. ***Keywords:*** *Node analysis, mesh analysis, time constant*	**13**
III	**AC Circuit Analysis:** Sinusoidal Voltage and Current, Definition of Instantaneous, Peak, Peak to Peak, Root Mean Square and Average Values. Voltage-Current relationship in Resistor, Inductor and Capacitor, Phasor, Complex Impedance. **Power in AC Circuits:** Instantaneous Power, Average Power, Reactive Power, Power Factor. Sinusoidal Circuit Analysis for RL, RC and RLC Circuits. Resonance in Series and Parallel RLC Circuits, Frequency Response of Series and Parallel RLC Circuits, Quality (Q) Factor and Bandwidth. **Passive Filters:** Low Pass, High Pass, Band Pass and Band Stop. ***Keywords:*** *Root Mean Square and Average Values, Complex Impedance, Quality Factor, Bandwidth*	**18**
IV	**Network Theorems:** Principal of Duality, Superposition Theorem, Thevenin's Theorem, Norton's Theorem, Reciprocity Theorem, Millman's Theorem, Maximum Power Transfer Theorem. AC circuit analysis using Network theorems. **Two Port Networks:** Impedance (Z) Parameters, Admittance (Y) Parameters, Transmission (ABCD) Parameters. ***Keywords:*** *Impedance, Admittance & Transmission Parameters.*	**16**

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. S. Salivahanan, S. Pravin Kumar, Circuit Theory, Vikas Publishing House Pvt. Ltd. 2014. 2. John D. Rider, Networks, line and fields, PHI Second Edition 1989. 3. G. K. Mithal, Network Analysis, Khanna Publication, 4th Edition, 1997.
1. S. A. Nasar, Electric Circuits, Schaum's outline series, Tata McGraw Hill (2004) 2. Electrical Circuits, M. Nahvi and J. Edminister, Schaum's Outline Series, Tata McGraw Hill. (2005) 3. Robert L. Boylestad, Essentials of Circuit Analysis, Pearson Education (2004) 4. W. H. Hayt, J. E. Kemmerly, S. M. Durbin, Engineering Circuit Analysis, Tata McGraw Hill (2005) 5. Alexander and M. Sadiku, Fundamentals of Electric Circuits, McGraw Hill (2008)

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

Suggestive digital platform web links 1. Lectures: https://ocw.mit.edu/index.htm) 2. Videos: https://www.youtube.com/c/mitocw/search?query=circuit%20theory 3. https://en.wikipedia.org/wiki/Network_analysis_(electrical_circuits) 4. https://en.wikipedia.org/wiki/Th%C3%A9venin%27s_theorem 5. https://en.wikipedia.org/wiki/Superposition_theorem
Suggested equivalent online courses. 1. https://www.coursera.org/ 2. NPTEL E-Learning Courses

Department of Physics & Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **UG Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MNS-176
2.	Course Title	**Basic Circuit Theory and Network Analysis Lab**
3.	Course Type (Major / Minor/ Discipline Specific Elective / Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have mathematics group in 12thclass and should not have taken Electronics as a either major or general elective subject.
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Verify the network theorems and operation of typical electrical and electronic circuits. • Choose the appropriate equipment for measuring electrical quantities and verify the same for different circuits. • Prepare the technical report on the experiments carried.
6.	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hours**

Suggestive List of Practical to be performed inNetwork Analysis Laboratory

1. Familiarization with
   a) Resistance in series, parallel and series – Parallel.
   b) Capacitors & Inductors in series & Parallel.
   c) Multimeter – Checking of components.
   d) Voltage sources in series, parallel and series – Parallel
   e) Voltage and Current dividers
2. Measurement of Amplitude, Frequency & Phase difference using CRO.
3. Verification of Kirchoff's Law.
4. Verification of Norton's theorem.
5. Verification of Thevenin's Theorem.

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Subject: Electronics Name: ……

6. Verification of Superposition Theorem.
7. Verification of the Maximum Power Transfer Theorem.
8. RC Circuits: Time Constant, Differentiator, Integrator.
9. Designing of a Low Pass RC Filter and study of its Frequency Response.
10. Designing of a High Pass RC Filter and study of its Frequency Response.
11. Study of the Frequency Response of a Series LCR Circuit and determination of its (a)Resonant Frequency (b) Impedance at Resonance (c) Quality Factor Q (d) Band Width

PART-C: **LEARNING RSOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1.S. P. Chandra Rao, Electronics Laboratory Primer, S. Chand Company Pvt. Ltd.
Suggestive digital platform web links
1.http://vlabs.iitb.ac.in/vlabs-dev/labs/network_lab/labs/explist.php
Suggested equivalent online courses
SWAYAM Course: **……**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: Electronics Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**

Subject: **Physics**

1	Course Code	MJS-271
2	Course Title	**Core- Mechanics**
3	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Major**
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{tl} class.
5	Course Learning Outcomes (CLO)	The course would empower the student to develop the idea about the behavior of physical bodies. It will provide the basic concepts related to the motion of all the object around us in daily life. The students would be able to build foundation to various applied field in science and technology especially in the field of mechanical engineering. The student will acquire the knowledge of basic mathematical methods to solve the various problems in physics. The students will be able the understand the relativistic effect and the relation energy and mass.
6	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4 Hrs**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Historical background:** A brief historical background of mathematics and mechanics in the context of India and Indian culture. A brief biography of Varahamihira and Vikram Sarabhai With their major contribution to	15

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

	science and society. **Fundamentals of Dynamics:** Reference frames, Inertial frames; Review of Newton's Laws of Motion. Galilean transformations; Galilean invariance. *Momentum of variable-mass system:* motion of rocket. System of particles. Centre of Mass. Principle of conservation of momentum. Impulse. *Work and energy:* Work and Kinetic Energy Theorem. Conservative and nonconservative forces. Potential Energy. Energy diagram. Elastic potential energy. Force as gradient of potential energy. Work & Potential energy. Work done by nonconservative forces.Elastic and inelastic collisions between particles. Centre of Mass. ***Keywords:*** *Kinetic energy, Galilean transformations, Center of mass.*	
II	**Rotational Dynamics:** Angular momentum of a particle and system of particles, Torque, Principle of conservation of angular momentum, Rotation about a fixed axis, Moment of Inertia; Calculation of moment of inertia for rectangular, cylindrical and spherical bodies; Kinetic energy of rotation. **Elasticity:** Relation between Elastic constants, Twisting torque on a Cylinder or Wire. **Fluid Motion:** *Kinematics of Moving Fluids:* Poiseuille's Equation for Flow of a liquid through a Capillary Tube. ***Keywords:*** *Angular momentum, Inertia, Fluid*	15
III	**Gravitation and Central Force Motion:** Law of gravitation, Gravitational potential energy, Potential and field due to spherical shell and solid sphere; Motion of a particle under a central force field; Two-body problem and its reduction to one-body problem and its solution; The energy equation and energy diagram; Kepler's Laws, Satellite in circular orbit and applications, Geosynchronous orbits, Weightlessness. **Oscillations:** *SHM:* Simple Harmonic Oscillations. Differential equation of SHM and its solution. Kinetic energy, potential energy, total energy and their time-average values. Damped oscillation. *Forced oscillations:* Transient and steady states; Resonance, sharpness of resonance; Power dissipation and Quality factor. ***Keywords:*** *SHM, Gravitation, Oscillation, Quality factor.*	15

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

IV	**Non-Inertial Systems:** Non-inertial frames and fictitious forces. Uniformly rotating frame. Centrifugal force. Coriolis force and its applications. Components of Velocity and Acceleration in Cartesian Coordinate system. **Special Theory of Relativity:** Michelson-Morley Experiment and its outcome. Postulates of Special theory of Relativity. Lorentz Transformations. Simultaneity and order of events. Lorentz contraction. Time dilation. Relativistic transformation of velocity, Relativistic addition of velocities. Variation of mass with velocity. Massless Particles. Mass energy Equivalence. ***Keywords:*** *Centrifugal force, Relativity, Lorentz Transformations, Lorentz contraction, Time dilation.*	15

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1.Mechanics, D.S. Mathur, S. Chand and Company

Reference Book:

1. An introduction to mechanics, D. Kleppner, R.J. Kolenkow, 1973, McGraw-Hill.
2. Mechanics, Berkeley Physics, vol.-1, C. Kittel, W. Knight, et.al. 2007, Tata McGraw-Hill.
3. Physics, Resnick, Halliday and Walker 8/e. 2008, Wiley.
4. Analytical Mechanics, G.R. Fowles and G.L. Cassiday, 2005, Cengage Learning
5. Feynman Lectures, Vol.-I, R.P. Feynman, R.B. Leighton, M. Sands, 2008, Pearson Education
6. Introduction to Special Relativity, R. Resnick, 2005, John Wiley and Sons.
7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole.

Suggestive digital platform web links

https://en.wikipedia.org/wiki/Galilean_transformation

https://en.wikipedia.org/wiki/Mechanics

https://link.springer.com/chapter/10.1007/978-3-030-15195-9_9

https://www.lkouniv.ac.in/site/writereaddata/siteContent/20200426125814514 8brijesh_engg_Elastic_Constants.pdfhttps://en.wikipedia.org/wiki/Special_relativity

Suggested equivalent online courses

NPTEL Courses: NA

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics and Electronics

(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**
Subject: **Physics**			

1	Course Code	MJS-271
2	Course Title	**Core- Mechanics Lab**
3	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Major**
4	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{tl} class.
5	Course Learning Outcomes (CLO)	The course would empower the student to develop the idea about the behavior of physical bodies. It will provide the basic concepts related to the motion of all the object around us in daily life. The students would be able to build foundation to various applied field in science and technology especially in the field of mechanical engineering. The student will acquire the knowledge of basic mathematical methods to solve the various problems in physics. The students will be able the understand the relativistic effect and the relation energy and mass.
	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hr**

Suggestive list of experiments:

1. Measurements of length (or diameter) using vernier-calipers, screw-gauge & travelling microscope.
2. To study the error in observations.
3. To determine the height of a building using a Sextant.
4. To study the Motion of Spring and calculate (a) Spring constant, (b) **g** and (c) Modulus of rigidity.
5. To determine the Moment of Inertia of a Flywheel.

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

6. To determine Coefficient of Viscosity of water by Capillary Flow Method (Poiseuille's method).
7. To determine the Young's Modulus of a Wire by Optical Lever Method.
8. To determine the Modulus of Rigidity of a Wire by Maxwell's Needle.
9. To determine the Elastic constants of a wire by Searle's method.
10. To determine the value of ***g*** using Bar Pendulum.
11. To determine the value of ***g*** using Kater's Pendulum.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: *Practical Physics for BSc first Year, Dr. B.K. Sinha, Ram Prasad and Sons.*
Reference Books: 1. Practical Physics for students, B. L. Flint and H.T. Worsnop, 1971, Asia Publishing House 2. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 3. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Edn, 2011, Kitab Mahal 4.Engineering Practical Physics, S. Panigrahi & B. Mallick,2015, Cengage Learning India Pvt. Ltd. 5.Practical Physics, G.L. Squires, 2015, 4th Edition, Cambridge University Press.
Suggestive digital platform web links:
https://en.wikipedia.org/wiki/Sextanthttps://en.wikipedia.org/wiki/Calipers https://www.brainkart.com/article/Determination-of-coefficient-of-viscosity-of-water-by-Poiseuille-s-flowmethod_3059/https://universe.bits-pilani.ac.in/uploads/Pilani/navin/ReadPDFDOC/YM.pdfhttps://dkpandey.weebly.com/uploads/1/3/5/3/13534845/maxwell_needle.pdfhttps://www.concepts-of-physics.com/searle-method/searle-method.php https://gfgc.kar.nic.in/davanagere-women/GenericDocHandler/166-a27e1694-5dcb-42cf-8939c5e07033108b.pdf https://en.wikipedia.org/wiki/Kater%27s_pendulum
Suggested equivalent online courses:
NPTEL Courses: NA

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***

Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session:*wef***2021-22**
Subject: **Physics**			

1.	Course Code	MJS-171
2.	Course Title	**Core- Thermal Physics**
3.	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Major**
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class.
5.	Course Learning Outcomes(CLO)	1. The course would enable students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter. 2. The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work". 3. This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics. 4. Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.
6.	Credit Value	**4(L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4Hours**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Introduction to Thermodynamics** **Historical background:** A brief historical background of thermodynamics and statistical Physics in the context of India and Indian culture, Contribution of S. N. Bose in statistical Physics.	**18**

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

	Zeroth and First Law of Thermodynamics: Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, *Applications of First Law:* General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes. **Second Law of Thermodynamics**: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, *2^{nd} Law of Thermodynamics:* Kelvin Planck and Clausius Statements and their Equivalence. Carnot's Theorem. *Applications of Second Law of Thermodynamics:* Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. ***Keywords:*** *Thermodynamics*, *Heat Engines*, *Carnot's Cycle.*	
II	**Entropy**: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. **Thermodynamic Potentials**: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation. ***Keywords:*** *Entropy*, *Clausius Clapeyron equation*	**14**
III	**Maxwell's Thermodynamic Relations**: Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of $C_p - C_v$, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Vander Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. **Kinetic Theory of Gases Distribution of Velocities**: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. ***Keywords:*** *Maxwells relations*, *Specific heat*, *Degrees of Freedom. Law of Equipartition of Energy.*	**14**
IV	**Molecular Collisions**: Mean Free Path. Collision Probability. Estimates of Mean	**14**

Date of BOS: ..... Signature of the Chairmen(BOS):

Subject: ..... Name: .....

	Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. **Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and Gaseous State. Vapour and Gas. Boyle Temperature. Vander Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. ***Keywords:*** *Brownian Motion, Joule-Thomson Effect, Vander Waal's Equation of State*	

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1.Physics for degree students B.Sc. Second Year, S. Chand and Company.

Reference Book:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
1. Thermal Physics, B.K. Agrawal, Lok Bharti Publications.

Suggestive digital platform web links

- https://en.wikipedia.org/wiki/Thermodynamics#:~:text=Thermodynamics%20is%20a%20branch%20of,and%20physical%20properties%20of%20matterhttps://en.wikipedia.org/wiki/Laws_of_thermodynamics
- https://en.wikipedia.org/wiki/Second_law_of_thermodynamicshttps://en.wikipedia.org/wiki/Entropy
- https://en.wikipedia.org/wiki/Maxwell_relations
- https://en.wikipedia.org/wiki/Maxwell%E2%80%93Boltzmann_distribution

Suggested equivalent online courses

NPTEL/SWAYAM Course:

Concepts of Thermodynamics, By Prof. Suman Chakraborty, Prof. Aditya Bandopadhyay, IIT Kharagpur.

Date of BOS: ..... Signature of the Chairmen(BOS):

Subject: ..... Name: .....

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics

(Syllabus: For Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **I**	Session: *wef***2021-22**
Subject: **Physics**			

1.	Course Code	MJS-171
2.	Course Title	**Core- Thermal Physics Lab**
3.	Course Type (Major/Minor/ Specific Elective/Generic Elective)	**Major**
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12th class.
5.	Course Learning Outcomes (CLO)	1. The student would gain practical knowledge about heat and radiation by performing various experiments. 2. The students will acquire knowledge about the different forms of distribution of subatomic particles in the system using statistical methods. 3. The students will be able to use various thermodynamical instruments in daily life.
6.	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hr**

Suggestive list of experiments:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To study thermal conductivity of rubber tube.
6. To study Stefan Constant.
7. To study ratio of specific heats.
8. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).
9. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

10. To calibrate a thermocouple to measure temperature in a specified Range using (1) Null Method, (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing. 2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal 3. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal,1985, Vani Pub.
Suggestive digital platform web links
1. https://www.vlab.co.in/broad-area-physical-ciences 2. https://storage.googleeapis.com/uniquecourse/online.html
Suggested equivalent online courses
SWAYAM Course: **……**

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics
(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session:*wef***2021-22**
Subject: **Physics**			

1.	Course Code	MNS-272
2.	Course Title	**Thermal Physics**
3.	Course Type (Major/Minor/ Open Elective/Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or general elective subject.
5.	Course Learning Outcomes(CLO)	1. The course would enable students to understand the basic Physics of heat and temperature in relation to energy, work, radiation and matter. 2. The students are expected to learn that "how laws of thermodynamics are used in a heat engine to transform heat into work". 3. This course will also develop an understanding of the various concepts of statistics and the methods to apply them in thermodynamics. 4. Students will understand the importance of studying statistical mechanics with the behavior of particles under classical and quantum conditions.
6.	Credit Value	**4(L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4Hours**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Introduction to Thermodynamics** **Historical background:** A brief historical background of thermodynamics and statistical Physics in the context of	**18**

Date of BOS: …… Signature of the Chairmen(BOS):
Subject: …… Name: ……

	India and Indian culture, Contribution of S. N. Bose in statistical Physics. **Zeroth and First Law of Thermodynamics**: Thermodynamic Variables, Thermodynamic Equilibrium, Zeroth Law of Thermodynamics & Concept of Temperature, Concept of Work & Heat, State Functions, First Law of Thermodynamics and its differential form, Internal Energy, First Law & various processes, *Applications of First Law:* General Relation between C_P and C_V, Work Done during Isothermal and Adiabatic Processes. **Second Law of Thermodynamics**: Reversible and Irreversible process with examples. Conversion of Work into Heat and Heat into Work. Heat Engines. Carnot's Cycle, Carnot engine & efficiency. Refrigerator & coefficient of performance, *2nd Law of Thermodynamics:* Kelvin Planck and Clausius Statements and their Equivalence. Carnot's Theorem. *Applications of Second Law of Thermodynamics:* Thermodynamic Scale of Temperature and its Equivalence to Perfect Gas Scale. ***Keywords:*** *Thermodynamics, Heat Engines, Carnot's Cycle.*	
II	**Entropy**: Concept of Entropy, Clausius Theorem. Clausius Inequality, Second Law of Thermodynamics in terms of Entropy. Entropy of a perfect gas. Principle of Increase of Entropy. Entropy Changes in Reversible and Irreversible processes with examples. Entropy of the Universe. Entropy Changes in Reversible and Irreversible Processes. Principle of Increase of Entropy. Temperature–Entropy diagrams for Carnot's Cycle. Third Law of Thermodynamics. **Thermodynamic Potentials**: Thermodynamic Potentials: Internal Energy, Enthalpy, Helmholtz Free Energy, Gibb's Free Energy. Their Definitions, Properties and Applications. Cooling due to adiabatic demagnetization, First and second order Phase Transitions with examples, Clausius Clapeyron Equation. ***Keywords:*** *Entropy, Clausius Clapeyron equation*	**14**
III	**Maxwell's Thermodynamic Relations**: Derivations and applications of Maxwell's Relations, Maxwell's Relations: (1) Clausius Clapeyron equation, (2) Values of $C_p - C_v$, (3) TdS Equations, (4) Joule-Kelvin coefficient for Ideal and Vander Waal Gases, (5) Energy equations, (6) Change of Temperature during Adiabatic Process. **Kinetic Theory of Gases Distribution of Velocities**: Maxwell-Boltzmann Law of Distribution of Velocities in an Ideal Gas and its Experimental Verification. Stern's Experiment. Mean, RMS and Most Probable Speeds. Degrees of Freedom. Law of Equipartition of Energy (No proof required). Specific heats of Gases. ***Keywords:*** *Maxwells relations, Specific heat, Degrees of Freedom. Law of Equipartition of Energy.*	**14**
IV	**Molecular Collisions**: Mean Free Path. Collision Probability. Estimates of Mean Free Path. Transport Phenomenon in Ideal Gases: (1) Viscosity, (2) Thermal Conductivity and (3) Diffusion. Brownian Motion and its Significance. **Real Gases:** Behavior of Real Gases: Deviations from the Ideal Gas Equation. The Virial Equation. Andrew's Experiments on CO_2 Gas. Critical Constants. Continuity of Liquid and	**14**

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

	Gaseous State. Vapour and Gas. Boyle Temperature. Vander Waal's Equation of State for Real Gases. Values of Critical Constants. Law of Corresponding States. Comparison with Experimental Curves. P-V Diagrams. Joule's Experiment. Free Adiabatic Expansion of a Perfect Gas. Joule-Thomson Porous Plug Experiment. Joule-Thomson Effect for Real and Van der Waal Gases. Temperature of Inversion. Joule-Thomson Cooling. ***Keywords:*** *Brownian Motion, Joule-Thomson Effect, Vander Waal's Equation of State*	

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1.Physics for degree students B.Sc. Second Year, S. Chand and Company.

Reference Book:

1. Heat and Thermodynamics, M.W. Zemansky, Richard Dittman, 1981, McGraw-Hill.
2. A Treatise on Heat, Meghnad Saha, and B.N. Srivastava, 1958, Indian Press
3. Thermal Physics, S. Garg, R. Bansal and Ghosh, 2nd Edition, 1993, Tata McGraw-Hill
4. Modern Thermodynamics with Statistical Mechanics, Carl S. Helrich, 2009, Springer.
5. Thermodynamics, Kinetic Theory & Statistical Thermodynamics, Sears & Salinger. 1988, Narosa.
6. Concepts in Thermal Physics, S.J. Blundell and K.M. Blundell, 2nd Ed., 2012, Oxford University Press
7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, R. Chand Publications.
1. Thermal Physics, B.K. Agrawal, Lok Bharti Publications.

Suggestive digital platform web links

- https://en.wikipedia.org/wiki/Thermodynamics#:~:text=Thermodynamics%20is%20a%20branch%20of,and%20physical%20properties%20of%20matterhttps://en.wikipedia.org/wiki/Laws_of_thermodynamics
- https://en.wikipedia.org/wiki/Second_law_of_thermodynamicshttps://en.wikipedia.org/wiki/Entropy
- https://en.wikipedia.org/wiki/Maxwell_relations
- https://en.wikipedia.org/wiki/Maxwell%E2%80%93Boltzmann_distribution

Suggested equivalent online courses

NPTEL/SWAYAM Course:

Concepts of Thermodynamics, By Prof. Suman Chakraborty, Prof. Aditya Bandopadhyay, IIT Kharagpur

Date of BOS: ..... Signature of the Chairmen(BOS):

Subject: ..... Name: .....

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics

(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef***2021-22**
Subject: **Physics**			

1.	Course Code	MNS-272
2.	Course Title	**Thermal Physics Lab**
3.	Course Type (Major/Minor/ Specific Elective/Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or general elective subject.
5.	Course Learning Outcomes (CLO)	1. The student would gain practical knowledge about heat and radiation by performing various experiments. 2. The students will acquire knowledge about the different forms of distribution of subatomic particles in the system using statistical methods. 3. The students will be able to use various thermodynamical instruments in daily life.
6.	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hr**

Suggestive list of experiments:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. To determine the Coefficient of Thermal Conductivity of Cu by Searle's Apparatus.
3. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
4. To determine the Coefficient of Thermal Conductivity of a bad conductor by Lee and Charlton's disc method.
5. To study thermal conductivity of rubber tube.
6. To study Stefan Constant.
7. To study ratio of specific heats.
8. To determine the Temperature Coefficient of Resistance by Platinum Resistance Thermometer (PRT).

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

9. To study the variation of Thermo-Emf of a Thermocouple with Difference of Temperature of its Two Junctions.
10. To calibrate a thermocouple to measure temperature in a specified Range using
    (1) Null Method,
    (2) Direct measurement using Op-Amp difference amplifier and to determine Neutral Temperature.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. Advanced Practical Physics for students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing. 2. A Text Book of Practical Physics, I. Prakash & Ramakrishna, 11th Ed., 2011, Kitab Mahal 3. Advanced level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers 4. A Laboratory Manual of Physics for undergraduate classes, D.P. Khandelwal,1985, Vani Pub.
Suggestive digital platform web links
1. https://www.vlab.co.in/broad-area-physical-ciences 2. https://storage.googleeapis.com/uniquecourse/online.html
Suggested equivalent online courses
SWAYAM Course: **……**

Date of BOS: …… Signature of the Chairmen(BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef***2022-23**
Subject: **Physics**			

1.	Course Code	GES-271
2.	Course Title	**Thermal Physics & Statistical Mechanics**
3.	Course Type (Core Course / Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-II** (Theory)
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12^{t1} class and should not have taken physics as a either major or minor subject.
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • learn the basic concepts of thermodynamics, the first and the second law of thermodynamics, the concept of entropy and the associated theorems, the thermodynamic potentials and their physical interpretations. They are also expected to learn Maxwell's thermodynamic relations. • know the fundamentals of the kinetic theory of gases, Maxwell-Boltzmann's distribution law, equipartition of energies, mean free path of molecular collisions, viscosity, thermal conductivity, diffusion and Brownian motion. • have a knowledge of the real gas equations, Vander Waal equation of state, the Joule-Thompson effect. • learn about the black body radiations, Stefan-Boltzmann's law, Rayleigh-Jean's law and Planck's law and their significances. • learn the quantum statistical distributions, viz., the BoseEinstein statistics and the Fermi-Dirac statistics.
6.	Credit Value	**Credits: 03**(Theory)

PART-B: **CONTENT OF THE COURSE**
Total No. of Lectures (in hours per week): **L – 3Hrs**
Total No. of Lectures: **L – 45**

Module	**Topics**	**No. of Lectures**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

I	**Laws of Thermodynamics:** *Thermodynamic description of system:* Zeroth Law of thermodynamics and temperature. First law and internal energy, conversion of heat into work, Various Thermodynamical Processes, *Applications of First Law:* General Relation between C_p and C_v, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient, Reversible and irreversible processes, Second law and Entropy, Carnot's cycle & theorem, Entropy changes in reversible & irreversible processes, Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of absolute zero.	**18**
II	**Thermodynamical Potentials:** Enthalpy, Gibbs, Helmholtz and Internal Energy functions, Maxwell's relations and applications - Joule-Thompson Effect, Clausius - Clapeyron Equation, Expression for ($C_P - C_V$), C_P/C_V, TdS equations. ***Keywords:*** *Enthalpy, Maxwell's Relations, Joule-Thompson Effect, Clausius Clapeyron Equation.*	**07**
III	**Kinetic Theory of Gases:** Derivation of Maxwell's law of distribution of velocities and its experimental verification, Mean-free-path (Zeroth Order), *Transport Phenomena:* Viscosity, Conduction and Diffusion (for vertical case), Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases. ***Keywords:*** *Mean-free-path, Transport Phenomena.*	**07**
IV	**Theory of Radiation:** Blackbody radiation, Spectral distribution, Concept of Energy Density, Derivation of Planck's law, Deduction of Wien's distribution law, Rayleigh-Jeans Law, Stefan Boltzmann Law and Wien's displacement law from Planck's law. ***Keywords:*** *Blackbody radiation, Planck's law.*	**05**
V	**Statistical Mechanics:** Phase space, Macrostate and Microstate, Entropy and Thermodynamic probability, Maxwell-Boltzmann law - distribution of velocity - Quantum statistics - Fermi-Dirac distribution law - electron gas, Bose-Einstein distribution law - photon gas, comparison of three statistics. ***Keywords:*** *Phase-space, Macro-state, Microstate, Quantum statistics.*	**08**

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings
Reference Books: 1. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, Tata McGraw-Hill. 2. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press. 3. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications. 4. Heat and Thermodynamics, M.W. Zemasky and R. Dittman, 1981, McGraw Hill 5. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears and G.L. Salinger. 1988, Narosa 6. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. 7. Thermal Physics, A. Kumar and S.P. Taneja, 2014, S. Chand Publications.
Suggestive digital platform web links
http://www.physics.usyd.edu.au/~helenj/Thermal/PDF/thermal1.pdf https://www.kanchiuniv.ac.in/phy/THERMAL%20PHYSICS%20MATERIAL_KR.pdfhttp://www.phys.ubbcluj.ro/~zneda/statfiz/books/Thermal%20physics%20-%20Kittel.pdfhttp://unaab.edu.ng/funaab-ocw/opencourseware/PHS%20222.pdf http://sites.science.oregonstate.edu/~roundyd/COURSES/ph441/thermal-physics.pdf
Suggested equivalent online courses
NPTEL Course: (1)Basic thermodynamics: Classical and Statistical Approaches, By Prof. Arnab Mukherjee, IISER Pune (2)Statistical Mechanics,By Prof. Dipanjan Chakraborty,IISER Mohali

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef***2022-23**
Subject: **PHYSICS**			
1.	Course Code	GES-271	
2.	Course Title	**Thermal Physics & Statistical Mechanics Lab**	
3.	Course Type (Core Course / Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-II** (Practical)	
4.	Pre-Requisite (if any)	To study this course, a student must have had the subject Physics in 12thclass and should not have taken physics as a either major or minor subject.	
5.	Course Learning Outcomes (CLO)	After completing this laboratory course student will be able to: (i) measurement of Planck's constant, (ii) determine Stefan's Constant, (iii) determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method, (iv) determine the temperature co-efficient of resistance by Platinum resistance thermometer, (v) study the variation of thermoemf across two junctions of a thermocouple with temperature, (vi) determine the coefficient of linear expansion by optical lever method, (vii) determine the pressure coefficient of air by constant volume method, (viii) determine the coefficient of linear expansion by travelling microscope, (ix) determine the coefficient of thermal conductivity of a bad conductor by Searle's method.	
6.	Credit Value	**1 (P)**	
PART-B: **CONTENT OF THE COURSE**			

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Total No. of Practical (in hours per week): **P – 2Hrs**

In the laboratory, the students are expected to perform the following experiments:

1. To determine Mechanical Equivalent of Heat, J, by Callender and Barne's constant flow method.
2. Measurement of Planck's constant using black body radiation.
3. To determine Stefan's Constant.
4. To determine the coefficient of thermal conductivity of Cu by Searle's Apparatus.
5. To determine the Coefficient of Thermal Conductivity of Cu by Angstrom's Method.
6. To determine the coefficient of thermal conductivity of a bad conductor by Lee and Charlton's disc method.
7. To determine the temperature co-efficient of resistance by Platinum resistance thermometer.
8. To study the variation of thermoemf across two junctions of a thermocouple with temperature.
9. To record and analyze the cooling temperature of a hot object as a function of time using a thermocouple and suitable data acquisition system
10. To calibrate Resistance Temperature Device (RTD) using Null Method/Off-Balance Bridge.

PART-C: **LEARNING RE**
Textbooks, Reference Books, C
Suggested Readings:
Recommended Books: 1. Advanced Practical Physics for Students, B.L. Flint & H.T. Worsnop, 1971, Asia Publishing House. 2. Advanced Level Physics Practical, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Ed 3. A Text Book of Practical Physics, Indu Prakash and Ramakrishna, 11th Edition, 2011, Kitab Mahal, New Delhi. 4. A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.
Suggestive digital platform web links
http://www.physics.usyd.edu.au/~helenj/Thermal/PDF/thermal1.pdfhttps://www.kanchiuniv.ac.in/phy/THERMAL%20PH %20Kittel.pdfhttp://unaab.edu.ng/funaab-ocw/opencourseware/PHS%20222.pdfhttp://sites.science.oregonstate.edu/~round

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Suggested equivalent online courses
SWAYAM Course: (1) Basic thermodynamics: Classical and Statistical Approaches, By Prof. Arnab Mukherjee, IISER Pune (2) Statistical Mechanics,By Prof. Dipanjan Chakraborty,IISER Mohali

Date of BOS: …… Signature of the Chairmen (BOS):

Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Structure for UG Programme: UGC CBCS System for Autonomous College ***(As Per Ordinance 14-A)***
Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	GES-275
2.	Course Title	**Digital System Design**
3.	Course Type (Major/Minor / Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-II (Theory)**
4.	Pre-Requisite (if any)	Open to all except the students of Electronics as either major or minor subject.
5.	Course Learning Outcomes (CLO)	**After completing this course student will be able to:** • Understand various number systems. • Perform interconversion of numbers of different number system. • Perform Arithmetic operation on numbers of different number system. • Simplify Boolean expressions. • Describe functions of various Logic gates. • Describe various logic families. • Describe working of combinational and sequential logic circuits.
6.	Credit Value	**3 (L)**

PART-B: **CONTENT OF THE COURSE**		
Total No. of Lectures (in hours per week): **L – 3 Hours**		
Total No. of Lectures: **L – 45**		
Module	**Topics**	**No. of Lectures**
I	**Number System and Codes:** Decimal, Binary, Hexadecimal, Octal, BCD, Conversions, Complements (1's and 2's), Signed and unsigned numbers, addition and subtraction, multiplication and division. Gray Codes. ***Keywords:*** *Number System, Signed and Unsigned numbers, Gray code*	**10**

Date of BOS: …… Signature of the Chairmen (BOS):

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II	**Boolean algebra and Logic gates:** Boolean algebra- Positive and negative logic. Boolean laws. De Morgan's theorems, simplification of Boolean expressions-SOP and POS. Logic gates- basic logic gates-AND, OR, NOT, logic symbol and truth table. Derived logic gates.(NAND, NOR, XOR & XNOR). Universal property of NOR and NAND gates. K-map-3 and 4 variable expressions. Characteristics of logic families: Fan In and Fan out, power dissipation and noise Immunity, propagation delay, comparison of TTL and CMOS families. ***Keywords:*** *Positive and negative logic, De Morgan's theorem, SOP, POS, Logic Gates, K-Map, Fan-In, Fan-ou, TTL and CMOSs families*	**15**
III	**Combinational logic analysis and design**: Multiplexers and Demultiplexers, Adder (half and full) and their use as subtractor, Encoder and Decoder, Code Converter (Binary to BCD and vice versa). ***Keywords:*** *Combinational logic, Code converter.*	**10**
IV	**Sequential logic design**: Latch, Flip flop, S-R FF, J-K FF, T and D type FFs, clocked FFs, registers, Counters (ripple, synchronous and asynchronous, ring, modulus). ***Keywords:*** *Flip-Flops, registers and counters.*	**10**

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1. M. Morris Mano Digital System Design, Pearson Education Asia,(Fourth Edition)
2. Thomas L. Flyod, Digital Fundamentals, Pearson Education Asia (1994)
3. B.Basavraj, "Digital Fundamentals", Vikas Publishing House Pvt. Ltd., New Delhi.
4. Jaydeep Chakravorty, "Digital Electronics and Logic Design", Universities Press (India) Private Limited, Hyderabad.

Reference books:

1. W. H. Gothmann, Digital Electronics: An Introduction To Theory And Practice, Prentice Hall of India (2000)
2. 2. R. L. Tokheim, Digital Principles, Schaum's Outline Series, Tata McGraw- Hill (1994)

Suggestive digital platform web links

1. https://www.coursera.org/learn/digital-systems
2. https://en.wikipedia.org/wiki/Digital_electronics
3. https://www.mooc-list.com/course/computation-structures-part-1-digital-circuits-edx
4. https://nptel.ac.in/courses/108/105/108105113/#

Suggested equivalent online courses

1. NPTEL Course:https://nptel.ac.in/courses/108/105/108105113#
2. *https://www.mooc-list.com/course/computation-structures-part-1-digital-circuits-edx*

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Subject: …… Name: ……

Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics and Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *wef* **2021-22**

Subject: **Electronic Science**		
1.	Course Code	GES-275
2.	Course Title	**Digital System Design**
3.	Course Type (Major /Minor/ Discipline Specific Elective / Generic Elective)	**Generic Elective: GE-II (Practical)**
4.	Pre-Requisite (if any)	Open to all except the students of Physics as either major or minor subject.
5.	Course Learning Outcomes (CLO)	**After completing this course student will be able to:** • Design and verify AND, OR, NOT and XOR gates • Realize the given simple Boolean expression by logic gates • Design a Half and Full Subtractor. • Design a Seven Segment display drive. • Design a 4 X 1 Multiplexer using gates. • Build a Flip- Flop (SRFF). • Design counters using D-FF, T-FF and JK-FF's. • Design and study Decoder (2x4, 3x8) • Design Code converters (Binary to Gray and vice versa). • Design 4-bit Ripple counter.
6.	Credit Value	**1 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 2 Hours**

Digital System Design Lab (Hardware and Circuit Simulation Software)Using trainer Boards

1. To verify truth table of AND, OR, NOT and XOR gates.
2. To design and verify truth table of AND, OR, NOT and XOR gates using NAND gates.
3. To convert a Boolean expression into logic gate circuit and assemble it using logicgate IC's.
4. Design a Half and Full Adder.
5. Design a Half and Full Subtractor.
6. Design a seven-segment display driver.

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7. Design a 4 X 1 Multiplexer using gates
8. To build a Flip- Flop Circuits using elementary gates. (RS, Clocked RS, D-type).
9. Design a counter using D/T/JK Flip-Flop.
10. Design a 4 bit Ripple Counter
11. Design a shift register and study Serial and parallel shifting of data.

Realization of following using Sci lab software:

1. Half adder, Full Adder using basic and derived gates.
2. Half subtractor and Full Subtractor using basic and derived gates.
3. Clocked D FF, T FF and JK FF (with Reset inputs).
4. Multiplexer (4x1, 8x1) and Demultiplexer using logic gates.
5. Decoder (2x4, 3x8), Encoders and Priority Encoders.
6. Design and simulation of a 4 bit Adder.
7. Code converters (Binary to Gray).
8. Code converters (Gray to Binary).
9. 4 bit Ripple counter

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. S.Salivahan, "Digital Electronics" 2. Will Kimber, "Practical Digital Electronics for Technicians", Publishers Newness. 3. M.Morris Mano, "Digital logic and Computer Design", Pearson Education India. 4. S, Poorna Chandra and B.Sasikala, "Electronics Laboratory Primer", S.Chand & Company Ltd. New Delhi. 5. A.K. Maini, "Digital Electronics Principles", Devices and applications", Wiley, 2007
Suggestive digital platform web: 5. https://www.coursera.org/learn/digital-systems 6. https://en.wikipedia.org/wiki/Digital_electronics 7. https://www.mooc-list.com/course/computation-structures-part-1-digital-circuits-edx 8. https://nptel.ac.in/courses/108/105/108105113/#
Suggested equivalent online courses
SWAYAM Course: https://swayam.gov.in Free Online Course: Digital Electronic circuit from IIT Kharagpur and NPTEL via SWAYAM www.classcentral.com>courses>swayam https://www.mooc-list.com/course/computation-structures-part-1-digital-circuits-edx

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Under 4 yrs. CBCS Course of B.Sc. (Honours/Research-*As Per Ordinance 14-A)*

Department of Physics & Electronics

(Syllabus: Theory Paper with Practical)

PART-A: **INTRODUCTION**			
Program: **Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *w.e.f* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MNS-276
2.	Course Title	**Semiconductor Devices**
3.	Course Type (Major /Minor/ Discipline Specific Elective / Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have mathematics group in 12th class and should not have taken Electronics as a either major or general elective subject in B.Sc. I sem.
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • describe the behaviour of semiconductor materials • reproduce the I-V characteristics of diode/BJT/MOSFET devices • apply standard device models to explain/calculate critical internal parameters of semiconductor devices • explain the behaviour and characteristics of power devices such as SCR/UJT etc.
6.	Credit Value	**4 (L)**

PART-B: **CONTENT OF THE COURSE**

Total No. of Lectures (in hours per week): **L – 4 Hours**

Total No. of Lectures: **L – 60**

Module	Topics	No. of Lectures
I	**Semiconductor Basics:** Introduction to Semiconductor Materials, Crystal Structure, Energy Band in Solids, Concept of Effective Mass, Density of States, Carrier Concentration at Normal Equilibrium in Intrinsic Semiconductors, Derivation of Fermi Level for Intrinsic & Extrinsic Semiconductors, Donors, Acceptors, Dependence of Fermi Level on Temperature and Doping Concentration, Temperature Dependence of Carrier Concentrations. **Carrier Transport Phenomena:** Carrier Drift, Mobility, Resistivity, Hall Effect, Diffusion Process, Einstein Relation, Current Density Equation, Carrier Injection, Generation and Recombination Processes, Continuity Equation. ***Keywords:*** *Semiconductor materials, Fermi Level, drift velocity.*	**14**

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Subject: …… Name: ……

II	**P-N Junction Diode:** Formation of Depletion Layer, Space Charge at a Junction, Derivation of Electrostatic Potential Difference at Thermal Equilibrium, Depletion Width and Depletion Capacitance of an Abrupt Junction. Concept of Linearly Graded Junction, Derivation of Diode Equation and I-V Characteristics. Zener and Avalanche Junction Breakdown Mechanism. Zener Diode, Tunnel diode, varactor diode, LED: circuit symbol, characteristics, applications ***Keywords:*** *PN Junction Diode, Depletion Layer, Zener Diode, LED*	**14**
III	**Bipolar Junction Transistors (BJT):** PNP and NPN Transistors, Basic Transistor Action, Emitter Efficiency, Base Transport Factor, Current Gain, Energy Band Diagram of Transistor in Thermal Equilibrium, Quantitative Analysis of Static Characteristics (Minority Carrier Distribution and Terminal Currents), Base-Width Modulation, Modes of operation, Input and Output Characteristics of CB, CE and CC Configurations. ***Keywords:*** *Bipolar Junction Transistor, Majority and Minority Carriers.*	**14**
IV	**Field Effect Transistors & Power Devices:** JFET, Construction, Idea of Channel Formation, Pinch-Off and Saturation Voltage, Current-Voltage Output Characteristics. MOSFET, types of MOSFETs, Circuit symbols, Working and Characteristic curves of Depletion type MOSFET (both N channel and P Channel) and Enhancement type MOSFET (both N channel and P channel). Complimentary MOS (CMOS). **UJT:** Basic construction and working, Equivalent circuit, intrinsic Standoff Ratio, Characteristics and relaxation oscillator-expression. **SCR:** Construction, Working and Characteristics, Diac, IGBT, MESFET, Circuit symbols, Basic constructional features, Operation and Applications. ***Keywords:*** *MOSFET, UJT, DIAC.*	**18**

PART-C: **LEARNING RESOURCES**

Textbooks, Reference Books, Other Resources

Suggested Readings:

Textbooks:

1. Electronic Circuits: Discrete &Integrated; Boylestad & Neshelsky, PHI.
2. A Text Book of Applied Electronics – R.S.Sedha, S. Chand & Company Ltd.

Reference Book:

3. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002).
4. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
5. Jasprit Singh, Semiconductor Devices: Basic Principles, John Wiley and Sons (2001)
6. Kanaan Kano, Semiconductor Devices, Pearson Education (2004)
7. ***Suggestive digital platform web links***

1. https://en.wikipedia.org/wiki/Semiconductor_device
2. https://www.electronics-tutorials.ws/diode/diode_1.html

Suggested equivalent online courses

MIT open course ware, MIT Course Number 6.012https://ocw.mit.edu/courses/electrical-engineering-and-computer-science/6-012-microelectronic-devices-and-circuits-fall-2009/

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Institute for Excellence in Higher Education (IEHE), Bhopal

Department of Physics & Electronics
(Syllabus: Practical Paper)

PART-A: **INTRODUCTION**			
Program: **UG Certificate**	Class: **B.Sc.**	Semester: **II**	Session: *w.e.f* **2021-22**
Subject: **Electronic Science**			

1.	Course Code	MNS-276
2.	Course Title	**Semiconductor Devices – Lab**
3.	Course Type (Major /Minor/ Discipline Specific Elective / Generic Elective)	**Minor**
4.	Pre-Requisite (if any)	To study this course, a student must have mathematics group in 12th class and should not have taken Electronics as a either major or general elective subject in B.Sc. I sem.
5.	Course Learning Outcomes (CLO)	After completing this course student will be able to: • Examine the characteristics of basic semiconductor devices. • Perform experiments for studying the behaviour of semiconductor devices for circuit design applications. • Calculate various device parameters' values from their IV characteristics. • Interpret the experimental data for better understanding the device behavior.
6.	Credit Value	**2 (P)**

PART-B: **CONTENT OF THE COURSE**
Total No. of Practical (in hours per week): **P – 4 Hours**

Suggestive List of Practical to be performed in Semiconductor Devices Lab

1. Study of Band Gap in a Junction Diode.
2. Study of Zener Regulated Power Supply.
3. Study of the I-V Characteristics of Diode – Ordinary and Zener Diode.
4. Study of the I-V Characteristics of the CE configuration of BJT and obtain β.
5. Study of the I-V Characteristics of the Common Base Configuration of BJT and obtain α.
6. Study of the I-V Characteristics of the Common Collector Configuration of BJT and obtain voltage gain.

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7. Study of the I-V Characteristics of the UJT.
8. Study of the I-V Characteristics of the SCR.
9. Study of the I-V Characteristics of JFET.
10. Study of the I-V Characteristics of MOSFET.
11. Study of Characteristics of Diac.

PART-C: **LEARNING RESOURCES**
Textbooks, Reference Books, Other Resources
Suggested Readings:
Textbooks: 1. S. M. Sze, Semiconductor Devices: Physics and Technology, 2ndEdition, Wiley India edition (2002). 2. Ben G Streetman and S. Banerjee, Solid State Electronic Devices, Pearson Education (2006)
Suggestive digital platform web links
http://vlabs.iitkgp.ac.in/be/#
Suggested equivalent online courses

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Subject: …… Name: ……