K. C. E. Society's
Moolji Jaitha College
An 'Autonomous College' Affiliated to
K.B.C. North Maharashtra University, Jalgaon.
NAAC Reaccredited Grade - A (CGPA : 3.15 - 3rd Cycle)
UGC honoured "College of Excellence" (2014-2019)
DST(FIST) Assisted College

KNOWLEDGE IS POWER
ESTD. 1945

के. सी. ई. सोसायटीचे
मूळजी जेठा महाविद्यालय
क.ब.चौ. उत्तर महाराष्ट्र विद्यापीठ, जळगाव संलग्नित
'स्वायत्त महाविद्यालय'
नॅकद्वारा पुनर्मानांकित श्रेणी – 'ए' (सी.जी.पी.ए. : ३.१५ – तिसरी फेरी)
विद्यापीठ अनुदान आयोगाद्वारा घोषित 'कॉलेज ऑफ एक्सलन्स' (२०१४-२०१९)
डी.एस.टी. (फीस्ट) अंतर्गत अर्थसहाय्य प्राप्त

Date :- 01/08/2024

NOTIFICATION

Sub :- CBCS Syllabi of B. Sc. in Physics (Sem. III & IV)

Ref. :- Decision of the Academic Council at its meeting held on 27/07/2024.

The Syllabi of B. Sc. in Physics (Third and Fourth Semesters) as per **NATIONAL EDUCATION POLICY – 2020 (2023 Pattern)** and approved by the Academic Council as referred above are hereby notified for implementation with effect from the academic year 2024-25.

Copy of the Syllabi Shall be downloaded from the College Website (www.kcesmjcollege.in)

Sd/-
Chairman,
Board of Studies

To :

1) The Head of the Dept., M. J. College, Jalgaon.
2) The office of the COE, M. J. College, Jalgaon.
3) The office of the Registrar, M. J. College, Jalgaon.

Near Samarth Colony, Jalgaon - 425 002. (Maharashtra, India) | Ph. : +91 257 - 2237363, 2234281 | e-mail : mjcollege@kces.in | Website : mjcollege.kces.in
समर्थ कॉलनी जवळ, जळगांव – ४२५ ००२. (महाराष्ट्र, भारत) । दूरध्वनी क्र. : +९१ २५७–२२३७३६३, २२३४२८१ । ई–मेलः mjcollege@kces.in । वेबसाईटः mjcollege.kces.in

Khandesh College Education Society's

Moolji Jaitha College, Jalgaon

An "Autonomous College"

Affiliated to K.B.C. North Maharashtra University, Jalgaon

SYLLABUS

S.Y.B.Sc. Physics

Under Choice Based Credit System (CBCS)
and
as per NEP-2020 Guidelines

[w.e.f. Academic Year : 2024-25]

Preface

In present scenario, manpower with skill, knowledge and talent are highly demanded. Person may be born talented but knowledge and skill acquired through learning of theoretical concept and hand-on laboratory method of subject. In order to achieve skill and knowledge, higher education system establishes NEP in 2020. The Moolji Jaitha College (Autonomous) adopt department-specific model as per NEP-2020, guideline of UGC, and Government of Maharashtra. The syllabus is designed for first-year undergraduate of Physics by Board of Studies of Physics of college. The syllabus developed knowledge in leaner through theoretical and practical hand-on from different fields of physics. Designed syllabus include basic and fundamental fact of different branches of physics. It may help to strong and clear based for various classical and modern branches of subject. After completion of syllabus learner able to understand various fact in environment using physics also able to apply scientific knowledge toward world. It enhance scienfic temperament of learner hence make them able to see world from frame of science.

The whole curriculum of three/four years covers different types of motion, mechanics, sound and optics, thermodynamics, mathematical physics, quantum mechanics, electrodynamics, basic electronics mobile communication, solar technology, battery technology. It also covervaccum technology and research methodology. Syllabus is designed to fulfil need from different areas such as research, industrial sector, Entrepreneurship etc. emphasizing imparting hands-on skills. Hence, the curriculum is endowed with more experiments that shall run hand-in-hand with theory. The detailed syllabus of each paper is appended with a list of suggested readings.

Program Outcomes (PO) for B.Sc. Program:

Upon successful completion of the B.Sc. program, student will be able to:

PO No.	PO
PO1	Understand the basic concepts and fundamental principles related to various science branches
PO2	Acquire the skills in handling scientific instruments and performing in laboratory experiments
PO 3	Relate various scientific phenomena and their relevancies in the day-to-day life.
PO4	Analyse experimental data critically and systematically to draw the objective conclusions.
PO 5	Develop various skills such as communication, leadership, teamwork, social, research etc., which will help in expressing ideas and views clearly
PO 6	Develop interdisciplinary approach for providing better solutions and sustainable developments.

Program Specific Outcome PSO (B.Sc. Physics):

After completion of this course, students are expected to learn/understand the:

PO No.	PSO
PSO1	Basic fundamental law in physics and may able to interpret it.
PSO2	Types, Properties and Factor affecting different physical quantities.
PSO 3	They are capable of independent and critical thinking
PSO 4	Students may able to evaluate and validate experimental result starting from principle also draw logical conclusion on the basis of result.
PSO 5	Students may able to pursue career in research, academics, industries and in allied field.
PSO 6	Acquire knowledge and skills appropriate to their professional activities.

Multiple Entry and Multiple Exit options:

The multiple entry and exit options with the award of UG certificate/ UG diploma/ or three-year degree depending upon the number of credits secured;

Levels	Qualification Title	Credit Requirements		Semester	Year
		Minimum	Maximum		
4.5	UG Certificate	40	44	2	1
5.0	UG Diploma	80	88	4	2
5.5	Three Year Bachelor's Degree	120	132	6	3
6.0	Bachelor's Degree- Honours **Or** Bachelor's Degree- Honours with Research	160	176	8	4

Credit distribution structure for Three/ Four year Honors/ Honors with Research Degree Programme with Multiple Entry and Exit

F.Y. B.Sc.

Year (Level)	Sem	Major (Core). Subjects		Minor Subjects (MIN)	GE/ OE	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int, RP	Cumulative Credits/Sem	Degree/ Cumulative Cr.
		Mandatory (DSC)	Elective (DSE)							
1 (4.5)	**I**	**DSC-1 (2T) DSC-2 (2T) DSC-3 (2P)**	—	**MIN-1 (2T) MIN-2 (2P)**	**OE-1 (2T)**	**SEC-1 (2T) SEC-2(1P)**	**AEC-1 (2T) (ENG) VEC-1 (2T) (ES) IKS (1T)**	**CC-1 (2)**	**22**	**UG Certificate**
	II	**DSC-4 (2T) DSC-5 (2T) DSC-6 (2P)**	...	**MIN-3 (2T) MIN-4 (2P)**	**OE-2 (2T)**	**SEC-3(2T) SEC-4(1P)**	**AEC-2 (2T) (ENG) VEC-2 (2T) (CI) IKS (1T)**	**CC-2 (2)**	**22**	
	Cum. Cr.	**12**	...	**8**	**4**	**6**	**10**	**4**	**44**	
Exit option: Award of UG Certificate in Major with 44 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major and Minor.										

S.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major*		Subject-II (M-2) Minor #	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
2 (5.0)	III	DSC-7(2T) DSC-8(2T) DSC-9(2P) DSC-10(2P)	---	MIN-5(2T) MIN-6(2T) MIN-7(2P)	---	OE-3(2T)		AEC-3(2T) (MIL)	CC-3(2T) CEP(2)	22	**UG Diploma**
	IV	DSC-11(2T) DSC-12(2T) DSC-13(2P) DSC-14(2P)	---	MIN-8(2T) MIN-9(2P)	---	OE-4(2T) OE-5(2P)		AEC-4(2T) (MIL)	CC-4(2T) ۞ FP(2)	22	
	Cum. Cr.	**12**	**---**	**10**	**---**	**4**	**6**	**4**	**8**	**44**	
	Exit option: Award of UG Diploma in Major and Minor with 88 credits and an additional 4 credits core NSQF course/ Internship OR Continue with Major & Minor.										

***** Student must choose one subject as a Major subject out of M-1, M-2 and M-3 that he/she has chosen at First year
#Student must choose one subject as a Minor subject out of M-1, M-2 and M-3 that he/she has chosen at First year (Minor must be other than Major)
۞ OJT/Internship/CEP should be completed in the summer vacation after 4th semester

T.Y. B.Sc.

Year (Level)	Sem	Subject-I (M-1) Major		Subject-II (M-2) Minor	Subject-III (M-3)	Open Elective (OE)	VSC, SEC (VSEC)	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
		Mandatory (DSC)	Elective (DSE)	(MIN)							
3 (5.5)	V	DSC-15(2T) DSC-16(2T) DSC-17(2T) DSC-18(2P) DSC-19(2P)	DSE-1A/B (2T) DSE-2A/B (2P)	---	---	---	VSC-1(2T) VSC-2(2P)	---	OJT/Int (4)	22	UG Degree
	VI	DSC-20(2T) DSC-21(2T) DSC-22(2T) DSC-23(2T) DSC-24(2T) IKS DSC-25(2P) DSC-26(2P)	DSE-3A/B (2T) DSE-4A/B (2P)	---	---	---	VSC-3(2T) VSC-4(2P)	---	---	22	
	Cum. Cr.	**24**	**8**	---	---	---	**8**	---	**4**	**44**	
	Exit option: Award of UG Degree in Major with 132 credits OR Continue with Major and Minor										

Fourth Year B.Sc. (Honours)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-27(4T) DSC-28(4T) DSC-29(4T) DSC-30(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	---	22	UG Honours Degree
	VIII	DSC-31(4T) DSC-32(4T) DSC-33(4T) DSC-34(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	OJT/Int (4)	22	
	Cum. Cr.	**28**	**8**	**4**	**---**	**---**	**---**	**4**	**44**	
Four Year UG Honors Degree in Major and Minor with 176 credits										

Fourth Year B.Sc. (Honours with Research)

Year (Level)	Sem	Major Core Subjects		Research Methodology (RM)	VSC, SEC (VSEC)	OE	AEC, VEC, IKS	CC, FP, CEP, OJT/Int/RP	Cumulative Credits/Sem	Degree/ Cumulative Credit
IV (6.0)	VII	DSC-27(4T) DSC-28(4T) DSC-30(2P)	DSE-5A/B (2T) DSE-6A/B (2P)	RM(4T)	---	---	---	RP(4)	22	UG Honours with Research Degree
	VIII	DSC-31(4T) DSC-32(4T) DSC-34(2P)	DSE-7A/B (2T) DSE-8A/B (2P)	---	---	---	---	RP(8)	22	
	Cum. Cr.	**20**	**8**	**4**	**---**	**---**	**---**	**12**	**44**	
Four Year UG Honours with Research Degree in Major and Minor with 176 credits										

Sem- Semester, **DSC**- Department Specific Course, **DSE**- Department Specific Elective, **OE/GE**- Open/Generic elective, **VSC**- Vocational Skill Course, **SEC**- Skill Enhancement Course, **VSEC**- Vocation and Skill Enhancement Course, **AEC**- Ability Enhancement Course, **IKS**- Indian Knowledge System, **VEC**- Value Education Course, **T**- Theory, **P**- Practical,**CC**-Co-curricular **RM**- Research Methodology, **OJT**- On Job Training, **FP**- Field Project, **Int**- Internship, **RP**- Research Project, **CEP**- Community Extension Programme, **ENG**- English, **CI**- Constitution of India, **MIL**- Modern Indian Laguage

- Number in bracket indicate credit
- The courses which do not have practical 'P' will be treated as theory 'T'
- If student select subject other than faculty in the subjects M-1, M-2 and M-3, then that subject will be treated as Minor subject, and cannot be selected as Major at second year.

Details of S.Y. B.Sc. (Physics)

Course	Course Type	Course Code	Course Title	Credits	Teaching Hours/ Week			Marks			
					T	P	Total	Internal		External	
								T	P	T	P
Semester III, Level – 5.0											
DSC-7	DSC	PHY-DSC-231	Heat and Thermodynamics	2	2	---	2	20	---	30	---
DSC-8	DSC	PHY-DSC-232	Basic Electronics	2	2	---	2	20	---	30	---
DSC-9	DSC	PHY-DSC-233	Practicals on Thermodynamics and Electronics I	2	---	4	4	---	20	---	30
DSC-10	DSC	PHY-DSC-234	Practicals on Thermodynamics and Electronics II	2	---	4	4	---	20	---	30
MIN-5	MIN	PHY-MIN-231	Semiconductor Devices	2	2	---	2	20	---	30	---
MIN-6	MIN	PHY-MIN-232	Mathematical tools in Physics	2	2	---	2	20	---	30	---
MIN-7	MIN	PHY-MIN-233	Practicals on Semiconductor Devices and Mathematical Physics	2	---	4	4	---	20	---	30
OE-3	OE	PHY-OE-231	Battery Technologies	2	2	---	2	20	---	30	---
CEP	CEP	PHY-CEP-231	Community Engagement Programme	2	---	4	4	50	---	---	---
Semester IV, Level – 5.0											
DSC-11	DSC	PHY-DSC-241	Waves and Oscillations	2	2	---	2	20	---	30	---
DSC-12	DSC	PHY-DSC-242	Optics	2	2	---	2	20	---	30	---
DSC-13	DSC	PHY-DSC-243	Practicals on Waves and Oscillations, Optics I	2	---	4	4	---	20	---	30
DSC-14	DSC	PHY-DSC-244	Practicals on Waves and Oscillations, Optics II	2	---	4	4	---	20	---	30
MIN-8	MIN	PHY-MIN-241	Modern Physics	2	2	---	2	20	---	30	---
MIN-9	MIN	PHY-MIN-242	Practical on Modern Physics	2	---	4	4	---	20	---	30
OE-4	OE	PHY-OE-241	Solar Cell Technologies	2	2	---	2	20	---	30	---
OE-5	OE	PHY-OE-242	Practicals on Solar Cell Technologies	2	---	4	4	---	20	---	30
FP	FP	PHY-FP-241	Field Project	2	---	4	4	50	---	---	---

Examination Pattern

Theory Question Paper Pattern:

- 30 (External) +20 (Internal) for 2 credits
    - External examination will be of 1½ hours duration
    - There shall be 3 questions: Q1 carrying 6 marks and Q2, Q3 carrying 12 marks each. The tentative pattern of question papers shall be as follows;
    - Q1 Attempt any 2 out of 3 sub-questions; each 3 marks
    - Q 2 and Q3 Attempt any 3 out of 4 sub-question; each 4 marks.

Rules of Continuous Internal Evaluation:

The Continuous Internal Evaluation for theory papers shall consist of two methods:

1. Continuous & Comprehensive Evaluation (CCE): CCE will carry a maximum of 30% weightage (30/15 marks) of the total marks for a course. Before the start of the academic session in each semester, the subject teacher should choose any three assessment methods from the following list, with each method carrying 10/5 marks:

i. Individual Assignments
ii. Seminars/Classroom Presentations/Quizzes
iii. Group Discussions/Class Discussion/Group Assignments
iv. Case studies/Case lets
v. Participatory & Industry-Integrated Learning/Field visits

vi. Practical activities/Problem Solving Exercises
vii. Participation in Seminars/Academic Events/Symposia, etc.
viii. Mini Projects/Capstone Projects
ix. Book review/Article review/Article preparation
x. Any other academic activity
xi. Each chosen CCE method shall be based on a particular unit of the syllabus, ensuring that three units of the syllabus are mapped to the CCEs.

2. Internal Assessment Tests (IAT): IAT will carry a maximum of 10% weightage (10/5 marks) of the total marks for a course. IAT shall be conducted at the end of the semester and will assess the remaining unit of the syllabus that was not covered by the CCEs. The subject teacher is at liberty to decide which units are to be assessed using CCEs and which unit is to be assessed on the basis of IAT. The overall weightage of Continuous Internal Evaluation (CCE + IAT) shall be 40% of the total marks for the course. The remaining 60% of the marks shall be allocated to the semester-end examinations. The subject teachers are required to communicate the chosen CCE methods and the corresponding syllabus units to the students at the beginning of the semester to ensure clarity and proper preparation.

Practical Examination Credit 2: Pattern (30+20)

External Practical Examination (30 marks):

- Practical examination shall be conducted by the respective department at the end of the semester.
- Practical examination will be of 3 hours duration and shall be conducted as per schedule.
- Practical examination shall be conducted for 2 consecutive days for 2 hr/ day where incubation condition is required.
- There shall be 05 marks for journal and viva-voce. Certified journal is compulsory to appear for practical examination.
- External practical examination of SEC will be of 25 marks and there will be no internal exam for SEC practical.

Internal Practical Examination (20 marks):

- Internal practical examination of 10 marks will be conducted by department as per schedule given.
- For internal practical examination student must produce the laboratory journal of practical completed along with the completion certificate signed by the concerned teacher and the Head of the department.
- There shall be continuous assessment of 30 marks based on student performance throughout the semester. This assessment can include quizzes, group discussions, presentations and other activities assigned by the faculty during regular practical. For details refer internal theory examination guidelines.
- Finally 40 (10+30) marks performance of student will be converted into 20 marks.

SEMESTER-III

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-231: Heat and Thermodynamics

Total Hours: 30 **Credits: 2**

Course Objectives	• To develop comprehension of fundamental thermodynamics concepts and principles. • To understand thermodynamic relations and cycles. • To impart knowledge of thermodynamic concepts through experiments. • To enhance the knowledge of kinetic theory of gases.	
Course outcomes	After the completion of this course Students will be able to…. • apply the concept of use of knowledge of thermal physics to real life problems. • use the first law of thermodynamics and calculate Heat, Internal energy, Work in a various thermo dynamical processes and systems. • estimate an entropy change in reversible and irreversible processes. • Study different thermodynamic cycles through demonstrations.	
Unit	**Topic Particular**	**Hours**
Unit I	**Basics of thermodynamics and its First Law:** • Thermodynamic Description of system, • Zeroth Law of thermodynamics and temperature. • First Law and internal energy, conversion of heat into work, Various Thermo dynamical Processes, • Applications of First Law: General Relation between CP and CV, Work Done during Isothermal and Adiabatic Processes, Compressibility and Expansion Coefficient.	**08**
Unit II	**Second and Third Law of Thermodynamics and Entropy**: • Reversible and irreversible Processes • Second law & Entropy, Entropy changes in reversible and irreversible Processes, • Entropy-temperature diagrams, Third law of thermodynamics, Unattainability of Absolute zero.	**07**
Unit III	**Thermodynamic relations, cycles and Heat Engines:** • Helmholtz and Gibb's functions, Gibb's relation, Maxwell relation,Joule-Thomson coefficient,Clausius-Clapeyron equation, • Introduction to Rankine cycle, Brayton cycle, Carnot's cycle, • Carnot's theorem & Carnot's Engine, Otto Engine and Cycle, DieselEngine and Cycle, Efficiencies of all heat Engines.	**08**
Unit IV	**Kinetic Theory of Gases:** • Mean free path (Zeroth Order), • Transport Phenomena: Viscosity, Conduction and Diffusion (for vertical case), Degrees of freedom, • Law of equipartition of energy (no derivation) and its applications to specific heat of gases; mono-atomic and diatomic gases.	**07**
References	1. Principles of Thermodynamics 1st Edition, Jean PhillipeAnsermet and Sylvain D Brechet, 28 Feb 20219, Cambridge University Press. 2. Thermal Physics, S. Garg, R. Bansal and C. Ghosh, 1993, TataMcGrawHill. 3. A Treatise on Heat, MeghnadSaha, and B.N. Srivastava, 1969, Indian Press. 4. Thermodynamics, Enrico Fermi, 1956, Courier Dover Publications. 5. Heat and Thermodynamics, M. W. Zemasky and R. Dittman, 1981, McGraw Hill 6. Thermodynamics, Kinetic theory & Statistical thermodynamics, F.W. Sears & G. L.Salinger.1988, Narosa. 7. University Physics, Ronald Lane Reese, 2003, Thomson Brooks/Cole. 8. Thermal Physics, A. Kumar and S. P. Taneja, 2014, R. Chand Publications	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-232: Basic Electronics

Total Hours: 30 **Credits: 2**

Course Objectives	• To understand the basic concepts of analog and digital electronics. • To understand the basic concepts and properties of semiconductors. • To get a basic idea about rectifier, transistor and power supply. • To acquire the basic knowledge of digital gates and Boolean algebra.	
Course outcomes	After the completion of this course Students will be able to…. • Analyze and distinguish the various electronic components such as resistor, capacitor, inductor, transformer, diode and transistor. • Use various rectifiers and power supplies. • Built various analog kits and circuits using different components. • Apply the various logic gates and design the logic circuit using Boolean algebra.	
Unit	**Topic Particular**	**Hours**
Unit I	**Semiconductor diodes:** • (Revision on metal, insulator and semiconductors, Intrinsic and Extrinsicsemiconductor), • Semiconductor Diodes: p and n type semiconductors. Barrier Formation in PN Junction Diode. • Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. • PN junction and its characteristics. Static and Dynamic Resistance. • Principle, Construction, Working and Characteristics of (1) LEDs (2) Photodiode (3) Solar Cell (P-N Junction), (4) Zener Diode	**7**
Unit II	**Rectifiers and Power Supplies:** • Introduction to Rectifiers, Types: Half-wave & Full-Wave Rectifiers (Centretapped and Bridge Rectifiers), • Calculation of Ripple Factor and Rectification Efficiency, Basic idea about capacitor filter, • D.C. power Supply (unregulated and regulated), Zener Diode as a voltage regulator.	**7**
Unit III	**Bipolar junction transistor :** • Bipolar Junction transistors: n-p-n and p-n-p Transistors. Characteristics of CB, CE and CC configurations. • Active, Cutoff, and Saturation Regions. Current gains α and β. Relations between α and β. • Load Line analysis of Transistors. DC Load line and Q point.	**7**
Unit IV	**Digital Electronics:** • Binary Numbers, Decimal to Binary and Binary to Decimal Conversion, Binary Addition, Binary Subtraction using 2's Complement Method, • AND, OR and NOT Gates (Realization using Diodes and Transistor), NAND and NOR Gates as Universal Gates, XOR and XNOR Gates, • De Morgan's Theorems, Boolean Laws, Simplification of Logic Circuit using Boolean Algebra.	**9**
References	1.Malvino A. P. Electronic Principles, (2019) McGraw-Hill Publishing House, New Delhi. Edition: 7 2. Ryder J. D. Electronic fundamentals and applications, (1970) Prentice Hall, 4th Edition, ISBN-10: 0132513552;	

	3. Mehta V. K. Principles of Electronics, S. Chand Publications, New Delhi, ISBN9788121924504 4 4. Allen Mottershead. Electronic Devices and Circuits, (1973) Good year Publishing Company, ISBN- 0608161306 5. Malvino and Leach. Digital Principles and Applications,(1993) McGraw-Hill Publication. ISBN- 9339203410 6. Jain R. P. Modern Digital Electronics,(2010) Tata McGraw-Hill Pvt. Ltd., New Delhi, ISBN- 97800706691 7. Millman J. and Halkias C.C. (1991). Integrated Electronics, Tata Mc-Graw Hill. 8. Salivahanan S. and Suresh Kumar N. (2012). Electronic devices and circuits, Tata Mc- Graw Hill. 9. Rashid M.H. (2011). Microelectronic Circuits, 2nd Edn, Cengage Learning. 10. Sedra A.S., Smith K.C., Chandorkar A.N. (2014). Microelectronic circuits, 6th Edn., Oxford University Press,ISBN 978–0–19–933913 11. Anand Kumar A. (2009). Fundamentals of Digital Circuits, 2nd Edition, PHI Learning Pvt. Ltd, ISBN: 9788120336797,	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-233: Practicals on Thermodynamics and Electronics I

Total Hours: 60 **Credits: 2**

Course Objectives	• To understand basics of heat and thermal energy. • To understand and verify the laws of thermodynamics. • To understand opearation of semiconductor devices. • To understand the digital logic gates.	
Course Outcomes	After the completion of this course Students will be able to…. • Understand and verify the practical aspects of thermodynamics. • Verification of thermal and thermodynamics laws. • Use semiconductor devices in real life applications. • Understand nature of molecules and energy in gases. • Use the learnt concepts to solve daily upcoming issues related to thermodynamics.	
Sr. No.	**Topic Particular**	**Hours**
1	To determine the coefficient of thermal conductivity of a bad conductor by Lee's method and Charlton's disc method.	4
2	To determine the coefficient of thermal conductivity of copper by Searle's Apparatus.	4
3	To determine thermal conductivity of rubber by tubing method.	4
4	To determine specific heat by Newton's law of cooling	4
5	To study the calibration of thermocouple for Temperature measurement.	4
6	To study the variation of thermo e. m. f. across two junctions of a thermocouple with temperature.	4
7	To demonstrate and understand working of 2-stroke and 4-stroke engines.	4
8	To determine characteristics of thermistor and to find an unknown temperature by using thermistor.	4
9	Use of thermocouple for measurement of temperature.	4
10	To demonstrate and understand working of the thermal and steam engine.	4
11	To determine the coefficient of linear expansion of metal.	4
12	To determine the specific heat of water/metal.	4
13	To verify Stefan's fourth power law using bulb.	4
14	To study the characteristics of Light Emitting Diode (LED).	4
15	To study the I–V characteristic of a p–n junction diode	4
16	To determine fill factor and efficiency of solar cell..	4
17	Comparison of luminous intensities of two light sources by using photo voltaic cell.	4
18	Study of logic gates (AND, OR and NOT) using diodes and transistors.	4
19	Verification of De Morgan's Theorems (using ICs).	4
References	• Dr. Dinesh V Kala (2020), Physics Practical Manual for UG & PG, InSc International Publisher • Flint B.L.&Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. New Delhi	

	• Michael Nelson and Jon M. Ogborn. Advanced level Physics Practicals, 4th Edition, reprinted 1985, Heinemann Educational Publishers. • InduPrakash and Ramakrishna (2011). A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. • Khandelwal D.P. (1985). A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication. New Delhi. • https://tempsens.com/blog/thermocouple-calibration	

.

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-DSC-234: Practicals on Thermodynamics and Electronics II

Total Hours: 60 **Credits: 2**

Course Objectives	• To give hands on training on thermodynamics experiments • To give hands on training on basic electronics experiments. • To give knowledge of advanced applications of semiconductor devices • To study the laws of thermodynamics by experimentation.	
Course Outcomes	After the completion of this course Students will be able to…. • Understand and verify the practical aspects of thermodynamics. • Test and use various electronic components such as resistor, capacitor, inductor, transformer, diode and transistor in electronic circuits. • Understand the various logic gates and design the logic circuit using Boolean algebra. • It will be helpful for them to apply this knowledge in industries	
Sr. No.	**Topic Particular**	**Hours**
1.	To Study of half wave rectifier with capacitor filter and to calculate its ripple factor.	**4**
2.	To Study of full wave bridge rectifier with capacitor filter and to calculate its ripple factor.	4
3.	To study the reverse characteristics of zener diode.	4
4.	To Study of zener diode as a voltage regulator.	4
5.	To study I-V characteristics of BJT.	
6.	To Study of CE transistor characteristics to find out 'β' of the transistor.	4
7.	To study Frequency response of CE single stage transistor amplifier and to calculate its bandwidth.	4
8.	Experimental verification of NAND gate as a universal building block.	4
9.	Experimental verification of NOR gate as a universal building block.	4
10.	Build and test BCD to Decimal convertor.	4
11.	Conversion of Binary number into decimal number.	4
12.	Conversion of decimal number into binary number.	4
13.	To study regulated power supply using 78xx/79xx.	4
14.	Identification and Testing of basic electronic components	4
15.	To determine mechanical equivalent of heat, J, by Callender and Barne's constant flow method.	4
16.	To determine thermal conductivity of metal by Forbe's method.	4
17.	Verification of Newton's law of cooling.	4
18.	To study the variation of thermo e. m. f. across two junctions of a thermocouple with temperature.	4
19.	Determine the melting temperature of Wax by using Platinum resistance thermometer.	4
20.	To determine color affects heating by absorption of light.	4
21.	To determine the mechanical equivalent of heat (J) with the help of Joules calorimeter.	4
References	• Flint B.L.&Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. New Delhi • Michael Nelson and Jon M. Ogborn. Advanced level Physics Practicals, 4th Edition, reprinted 1985, Heinemann	

	Educational Publishers • InduPrakash and Ramakrishna (2011). A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. • Khandelwal D.P. (1985). A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication. New Delhi	

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-231: Semiconductor Devices

Total Hours: 30 **Credits: 2**

Course Objectives	• To understand the fundamentals of basics semiconductor physics • To understand the formation of diode using semiconductors • To understand the basic concepts of rectifiers and transistors. • To provide problem solving experience and learning of concepts through it in Semiconductor Physics, in both the classroom and the laboratory learning environment.	
Course outcomes	After the completion of this course Students will be able to…. • Understand fundamentals of energy band theory in semiconducting materials. • Understand the basic of Intrinsic and Extrinsic Semiconductors. • Understand the concepts diodes, rectifiers and transistors and their applications in real life . • Analyze and apply the elementary understanding of the measurement techniques for semiconductor.	
Unit	**Topic Particular**	**Hours**
Unit I	**Theory of semiconductors:** • Conductors, insulator and semiconductors. • Types of semiconductors: Intrinsic and extrinsic semiconductors. • Band structure of semiconductors. • Carrier concentration in intrinsic and extrinsic semiconductors. • Electrical conductivity and conduction mechanism in semiconductors. • Fermi level in intrinsic and extrinsic semiconductors and its dependence on temperature and carrier concentration. • Carrier generation – recombination, mobility, drift-diffusion current. • Hall effect (Definition).	**08**
Unit II	**Semiconductor Diodes:** • PN junction diode and Barrier Formation in PN Junction Diode. • Qualitative Idea of Current Flow Mechanism in Forward and Reverse Biased Diode. • PN junction and its characteristics. • Static and Dynamic Resistance. • Principle, Construction, Working and Characteristics of (1) LEDs (2) Photodiode (3) Solar Cell (P-N Junction), (4) Zener Diode	**07**
Unit III	**Bipolar junction transistor** • Bipolar Junction transistors: n-p-n and p-n-p Transistors. • Characteristics of CB, CE and CC configurations. • Active, Cutoff, and Saturation Regions. • Current gains α and β and Relations between α and β. • Load Line analysis of Transistors. • DC Load line and Q point.	**07**
Unit IV	**Semiconductor device applications** • Introduction to Rectifiers • Types: Half-wave & Full-Wave Rectifiers (Centre-tapped and Bridge Rectifiers) • Calculation of Ripple Factor and Rectification Efficiency • Basic idea about capacitor filter • D.C. power Supply (unregulated and regulated) • Zener Diode as a voltage regulator • Transistor as an Amplifer	**08**

References	1. Electronic Principles – A. P. Malvino, McGraw-Hill Publishing House 2. Electronic fundamentals and applications – J. D. Ryder, Prentice Hall 4th Edition 3. Principles of Electronics – V. K. Mehta, S. Chand Publications, New Delhi 4. Electronic Devices and Circuits – Allen Mottershead, Good year Publishing Company 5. Digital Principles and Applications – Malvino and Leach, McGraw-Hill Publication. 6. Modern Digital Electronics – R. P. Jain, Tata McGraw-Hill Pvt. Ltd., New Delhi 7. Integrated Electronics, J. Millman and C.C. Halkias, 1991, Tata Mc-Graw Hill. 8. Electronic devices and circuits, S. Salivahanan and N. Suresh Kumar, 2012, Tata Mc-Graw Hill. 9. Microelectronic Circuits, M.H. Rashid, 2ndEdn.,2011, Cengage Learning. 10. Microelectronic circuits, A.S. Sedra, K.C. Smith, A.N. Chandorkar, 2014, 6th Edn., Oxford University Press. 11. Fundamentals of Digital Circuits, A. Anand Kumar, 2nd Edition, 2009, PHI Learning Pvt. Ltd.	

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-232: Mathematical Tools in Physics

Total Hours: 30 **Credits: 2**

Course objectives	• To impart knowledge of various physical, mathematical, and statistical quantities and its basic operations. • To provide the knowledge and methodology necessary for solving problems in Physics. • To understand the concept of scalars and vectors • The course also involves the related experiments based on the theory.	
Course outcomes	After the completion of this course Students will be able to…. • apply the concept of use of knowledge of physical, mathematical, and statistical quantities in real life problems. • help to understand types of error and method of finding error. • Apply the concept of scalars and vectors. • understand that the course will create scientific temperament.	
Unit	**Topic Particular**	**Hours**
Unit I	**Physical quantities and its dimensional analysis** • Units, Conditions for standard unit • System of units, Fundamental quantities and its dimensions • Derived quantities and its dimensions, Supplementary quantities • Dimensions and dimensional analysis • Uses of dimensional analysis • Limitations of dimensional analysis • Conventions followed in SI-Multiples & sub-multiples and prefixes of units.	**8**
Unit II	**Errors in Measurements** • Systematic errors • Random errors, Estimation of errors • Combination of errors- errors in sum • difference, product, division and powers • Determination of errors in instruments such as VernierCalliper, Micro meter screw gauge and Spherometer, • Significant figures and Rules for determining significant figures.	**7**
Unit III	**Scalar and Vectors** • Definition and examples of scalar and vector quantities, • Types of vectors, Vector Operations, • Triangle law of Vector addition, • Law of Parallelogram of Vectors, • Resolution of vectors, Multiplication of vectors- scalar product and vector product and their geometrical interpretation, • Vector product expressed as determinant, • volume of parallelogram, • Scalar triple product and its geometrical interpretation, • Volume of tetrahedron, • CollinearityCoplanarity of vectors.	**8**
Unit IV	**Statistical Techniques** • Statistics, Frequency distribution • Graphical Representation- Histogram, Frequency Polygon • Frequency curve, Cumulative Frequency curve or Ogive	**7**

	• Bar chart and Pie diagrams • Exclusive and Inclusive Class intervals • Arithmetic averages or Mean, Median, Mode • Geometric mean, Harmonic mean, standard deviation • Variance, Symmetry, Skewness and Kurtosis • Moments, Covariance • Correlation, Types of correlation • Karl Pearson's Coefficients of Correlation.	
Study Resources	• DasH. K. (2014), Mathematical Physics, Seventh Revised Edition, Chand Publishers. • VarmaH. C., Concept of Physics, Vol I, BharatiBhawan Publisher • GaikwadD. T., PadmakarS., RaneS. R. and MorankarV. (2011), Basic Physics, Chand Publisher. • RajputB. S. (1997), Mathematical Physics, PragatiPrakashan. • Roshan Kr. Sinha, Basic Physics, Foundation Publishing House.	

S.Y. B.Sc. Physics (Minor)
Semester-III
PHY-MIN-233: Practicals on Semiconductor Devices and Mathematical Physics

Total Hours: 60 **Credits: 2**

Course Objectives	• To understand concept of semiconductor. • To understand the forward and reverse characteristics of different diodes. • To understand the characteristics and various factors of rectifiers and transistors. • To develop the experimental skills of students.	
Course Outcomes	After the completion of this course Students will be able to…. • Apply the concept of use of knowledge of semiconductors to real life problems. • Understand the characteristics and various factors of diodes, rectifiers and transistors practically. • Able to handle the different components of semiconductors in Laboratory. • Understanding of the course will create scientific temperament.	
Sr. No.	**Topic Particular**	**Hours**
1	To plot V-I Characteristics of Silicon and Germanium P-N Junction Diodes.	4
2	To Study of half/ full wave rectifier with capacitor filter and to calculate its ripple factor.	4
3	To plot V-I Characteristics of Zener Diode.	4
4	To study Zener diode as a voltage regulators.	4
5	To study the characteristics of Light Emitting Diode (LED).	4
6	To determine fill factor and efficiency of solar cell.	4
7	To determine band gap of semiconductor (Si/ Ge)	4
8	To study resistivity of semiconductor material using Four Probe Method	4
9	Estimation of absolute error, relative error and percentage error from given data.	4
10	Measurements of length (or diameter or thickness) using vernier caliper, micrometer screw guage and travelling microcope of given objects.	4
11	To determine radius of curvature of given spherical surface by sphero meter.	4
12	To determine the mean, mode and median of the given data	4
13	To determine the Karl Pearson's Coefficient of Skewness from the given data.	4
14	Determine the dimensions of given physical quantities.	4
15	To check the correctness of given physical equations.	4
16	To determine the gradient, divergence and curl of given equations.	4
References	• Advanced Practical Physics for students, B.L.Flint&H.T.Worsnop, 1971, Asia Publishing House. • Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers • A Text Book of Practical Physics, InduPrakash and Ramakrishna, 11th Edition, 2011, KitabMahal, New Delhi. • A Laboratory Manual of Physics for Undergraduate Classes, D.P. Khandelwal, 1985, Vani Publication.	

	• College Practical Physics: Khanna and Gulati (S. Chand and Co. Ltd , Delhi) 11. Practical Physics: Gupta and Kumar (PragatiPrakashanMeerat) • Advanced Level Practical Physics: J. M.Nelkon, J.M.Ogloom (EIBS) • FlintB.L., and WorsnopH.T. (1971), Advanced Practical Physics for students, Asia Publishing House. • Das H. K. (2014), Mathematical Physics, Seventh Revised Edition, S. Chand Publishers. • Michael Nelson and OgbornJon M. (1985), Advanced level Physics Practicals, 4thEdition, reprinted, Heinemann Educational Publishers.	

Note: At least 12 practicals should be performed.

S.Y. B.Sc. Physics (Open Elective)
Semester-III
PHY-OE-231: Battery Technologies

Total Hours: 30 **Credits: 2**

Course Objectives	• To understand the different types of energy storage system. • To study about the battery characteristic & parameters. • To model the types of batteries • To study about the battery testing, disposal and recycling.	
Course outcomes	After the completion of this course Students will be able to…. • Discuss about the different types of energy storage system. • Describe about the battery characteristic & parameters. • Apply the concepts of battery management system and design the battery pack. • Explain about the battery testing, disposal and recycling.	
Unit	**Topic Particular**	**Hours**
Unit I	**Introduction to Batteries** • Overview of batteries: history, importance, and applications. • Basic components of batteries: electrodes, electrolytes, and separators. • Types of batteries: primary and secondary batteries. • Energy storage metrics: voltage, capacity, and energy density.	**6**
Unit II	**Electrochemistry of Batteries** • Electrochemical reactions: oxidation-reduction reactions and electron transfer. • Battery cell configurations: galvanic cells and half-cell reactions. • Electrode materials: properties and selection criteria. • Electrolyte solutions: types and role in battery performance	**9**
Unit III	**Battery Performance** • Charging and discharging processes: charge-discharge curves and voltage profiles. • Internal resistance and impedance: impact on battery performance. • Cycle life and degradation mechanisms: capacity fade and aging. • Safety considerations: overheating and short-circuiting.	**7**
Unit IV	**Advanced Battery Technologies** • Emerging battery technologies: lithium-ion, solid-state, and beyond. • Nanomaterials in battery technology: synthesis and applications. • Energy storage systems: applications in various industries. • Environmental impact and sustainability: recycling and eco-friendly alternatives.	**8**
References	• Armand, M., & Tarascon, J. M. (Eds.). (2008). Building Better Batteries. Springer. DOI: 10.1007/978-0-387-34445-4 • Goodenough, J. B., & Park, K. S. (2013). The Li-ion Rechargeable Battery: A Perspective. Springer. DOI: 10.1021/ja310466u • Bruce, P. G., Freunberger, S. A., Hardwick, L. J., & Tarascon, J. M. (Eds.). (2012). Li-O2 and Li-S Batteries with High Energy Storage. Springer. DOI: 10.1038/nmat3223 • Whittingham, M. S. (2012). History, Evolution, and Future Status of Energy Storage. Proceedings of the IEEE. DOI: 10.1109/JPROC.2011.2168369 • 5. Larcher, D., & Tarascon, J. M. (2015). Towards Greener and More Sustainable Batteries for Electrical Energy Storage. Nature Chemistry. DOI: 10.1038/nchem.2142	

S.Y. B.Sc. Physics (Major)
Semester-III
PHY-CEP-231: Community Engagement Program (CEP)

Course Structure : 2 Credits
Contact hours : 60 hours

In alignment with the National Education Policy (NEP) 2020, Moolji Jaitha College (Autonomous), Jalgaon is introducing the Community Engagement Program at the undergraduate level. The NEP 2020 emphasizes holistic development, inclusivity, and integrating vocational education with academic learning, aiming to nurture socially responsible individuals. Inspired by NEP 2020, the Community Engagement Program aim to produce knowledgeable, compassionate, and proactive graduates, contributing to a more just, equitable, and sustainable society. This course fosters a strong connection between education and socioeconomic problems of real-world. Students will learn about the challenges faced by vulnerable households and appreciate local wisdom and lifestyles.

Objectives

- To engage students in activities that promote emotional, social, and intellectual growth, fostering a well-rounded approach to personal and academic development.
- To provide hands-on experiences that complement classroom learning, enabling students to apply their knowledge insocioeconomic problems of real-world.
- To instil a sense of responsibility towards the community by encouraging students to actively participate in social and environmental initiatives, appreciate rural culture, lifestyle, and wisdom.

Learning Outcomes

After completing this course, students will be able to

- Understand rural and/or urban culture, ethos, and socioeconomic realities.
- Develop a sense of empathy with the local community while appreciating the significant contributions of local communities to society and the economy.
- Learn to value the local community wisdom and identify opportunities for contributing to the community's socioeconomic improvements.

Activities

- Conduct workshops and interactive sessions on emotional intelligence and social skills.
- Organize debates, discussions, and intellectual challenges that stimulate critical thinking and socioeconomic problem-solving using concern subject.
- Organize field visits where students can work on real-world problems, such as environmental conservation, rural and/or urban planning, or community health.
- Organize internships or service-learning opportunities with local businesses, NGOs, or government agencies.
- Facilitate project-based learning activities that require students to use their academic knowledge to develop solutions to community issues.
- Engage students in community service activities that address local social and environmental issues.
- Organize cultural exchange programs or field trips to rural areas to foster an appreciation of rural culture and wisdom.
- Facilitate collaborative projects involving students, educators, and community members to develop solutions for local challenges, promoting teamwork and collective problem-solving.
- Conduct educational sessions on the status of various agricultural and development programs and the challenges faced by vulnerable households, ensuring inclusivity and accessibility for all students.

S. No.	Module Title	Module Content	Assignment submission	Teaching/ Learning Methodology

1	**Appreciation of Rural Society**	Rural lifestyle, rural society, caste and gender relations, rural values with respect to community, nature and resources, elaboration of "soul of India lies in villages', rural infrastructure.	Prepare a map (physical, visual or digital) of the village you visited and write an essay about inter-family relations in that village.	– Classroom discussions – Field visit – Assignment
2	**Understanding rural and local economy and livelihood**	Agriculture, farming, land ownership, water management, animal husbandry, non-farm livelihoods and artisans, rural entrepreneurs, rural markets, migrant labour.	Describe your analysis of the rural house hold economy, its challenges and possible pathways to address. Circular economy and migration patterns.	– Field visit – Group discussions in class – Assignment
3	**Rural and local Institutions**	Traditional rural and community organisations, Self-help Groups, Panchayati raj institutions (Gram Sabha, Gram Panchayat, Standing Committees), Nagarpalikas and municipalities, local civil society, local administration.	How effectively are Panchayati Raj and Urban Local Bodies (ULBs) institutions functioning in the village? What would you suggest to improve their effectiveness? Present a case study (written or audio-visual).	– Classroom – Field visit – Group presentation of assignment
4	**Rural and National Development Programmes**	History of rural development and current national programmes in India: SarvaShikshaAbhiyan, BetiBachao, BetiPadhao, Ayushman Bharat, Swachh Bharat, PM AwaasYojana, Skill India, Gram Panchayat Decentralised Planning, National Rural Livelihood Mission (NRLM), Mahatma Gandhi National Rural Employment Guarantee Act 2005 (MGNREGA), SHRAM, Jal Jeevan Mission, Scheme of Fund for Regeneration of Traditional Industries (SFURTI), AtmaNirbhar Bharat, etc.	Describe the benefits received and challenges faced in the delivery of one of these programmes in the local community; give suggestions about improving the implementation of the programme for the poor. Special focus on the urban informal sector and migrant households.	– Classroom – Each student selects one program for field visit – Written assignment

Note: The modules are suggestive in nature and students can opt any one activities for community engagement program and field project based on topic appropriate to their regional community context.

Some additional suggestive themes for field-based / community engagement activities are listed below:

- Management curriculum may include aspects of micro-financing in a rural context;
- Chemistry syllabus can have a component of conducting water and soil analysis in surrounding field areas;
- Political science syllabus could include a mapping of local rural governance institutions and their functioning.

- Environment education will include areas such as climate change, pollution, waste management, sanitation, conservation of biological diversity, management of biological resources and biodiversity, forest and wildlife conservation, and sustainable development and living
- Understanding panchayats and constitutional mandate of local governance
- Panchayat administration, Gram Sabha, Mahila Sabha, Gram Panchayat Development Plan (GPDP), local planning of basic services.
- Micro-finance, SHGs, system of savings and credit for local business, linkages to banks, financial inclusion.
- Rural – entrepreneurship, opportunities for small business in local communities, access to financial and technical inputs to new entrepreneurs.
- Renewable energy, access to household and community level solar and bio-mass systems for sustainable energy use.
- Participatory Monitoring and evaluation of socio-economic development programmes, and cost-benefit analysis of project proposals.
- Migrant workers' livelihood security and social services.
- Hygiene and sanitation, improving health and personal behaviours, locally manageable decentralised systems and awareness against stubble burning.
- Water conservation, traditional practices of storage and harvesting, new systems of distribution and maintenance.
- Women's empowerment, gender inequality at home, community and public spaces, safety of girls and women, access to skills, credit and work opportunities.
- Child security, safety and good parenting, nutrition and health, learning and training for child care.
- Rural Marketing, market research, designing opportunities for rural artisans and crafts, and new products based on demand assessment.
- Community Based Research in Rural Settings, undertaking research that values local knowledge, systematises local practices and tools for replication and scale-up.
- Peri-urban development of informal settlements, mapping and enumeration, design of local solutions.

Assessment:

- Readings from related literature including e-content and reflections from field visits should be maintained by each student in the form of Field Diary (20 Marks)
- Submission of assignments based on modules assignment submission (details mentioned above) (20 Marks)
- Oral/ Group discussion/ Presentation (10 Marks)

SEMESTER-IV

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-241: Waves and Oscillations

Total Hours: 30 **Credits: 2**

Course Objectives	• To impart knowledge of basic concepts of Waves and Oscillations. • To study different basic parameters and types of waves. • To provide the knowledge and methodology necessary for solving problems of waves and acoustics. • To understand actual phenomena of forced and damping of oscillations.	
Course outcomes	After the completion of this course Students will be able to…. • Apply the concept of use of knowledge of Waves and Oscillation to real life problems. • Understanding of the course will create scientific temperament. • To create the ability of students towards application of sound knowledge of acoustics. • Interpretation of solutions for different waves equations.	
Unit	**Topic Particular**	**Hours**
Unit I	**Basics of SHM and Wave motion** • Different types of equilibria (stable, unstable, and neutral equilibrium), Definition of linear and angular S.H.M., Differential equation of S.H.M. and its solution (exponential form),Composition of two perpendicular linear S.H.Ms. for frequencies 1:1 and 1:2 (analytical method), Illustrative Numerical, Lissajous's figures and its uses, Applications (mechanical, electrical and optical). • Wave Motion General: Transverse waves on a string. Travelling and standing waves on a string. Normal Modes of a string. Plane waves, Spherical waves, Wave intensity,	**08**
Unit II	**Damped oscillation, Forced oscillations and Resonance** • Differential equation of a damped oscillator and its solutions, heavy damping, critical damping, weak damping; characterizing weak damping: logarithmic decrement; relaxation time, quality factor • Idea of forced oscillations, Differential equation of forced oscillations and its solution, Amplitude of forced oscillations, circuit Resonance and its types- Mechanical resonance (Barton's pendulum), Acoustic resonance (resonance tube), Electrical resonance (LCR circuit) and Optical resonance (sodium vapour lamp), Amplitude resonance, Application to series L-C-R.	**08**
Unit III	**Parameters of Sound Ultrasonic** • Sound intensity, Loudness, Pitch, Quality and timber, Acoustic intensity level measurement, Acoustic pressure and its measurement. Reverberation and time of reverberation. Fourier's Theorem: Application to saw tooth wave and square wave, • Classification of sound frequencies, Piezoelectric effect, Generation of ultrasonic waves by piezoelectric oscillator (using transistor), Application of ultrasonic waves.	**07**
Unit IV	**Doppler effect in sound and Light** • Expression for apparent frequency (no derivation), discussion of different cases when source, observer and medium are in relative motion, Asymmetric nature of Doppler effect in sound, • Doppler effect in light, Symmetric nature of Doppler effect in light, Applications of Doppler effect in sound and light.	**07**
References	1. Pain H J (2013). The Physics of Vibrations and Waves, Wiley ELBS, 7TH edition. 2. Ghosh R K (1975). The mathematics of waves and vibrations, Macmillan co. pvt ltd, New Dehi. 3. Khandelwal D.P., 1976Oscillations and Waves,Himalaya Pub. House, Bombay. 4. Ghosh M., 2016, A text book of Sound, S.Chand& Co.5th edition, ISBN 9385676156. 5. Brijlal and Subramaniyam.Waves and oscillations, Vikas Publishing House, ISBN 9780706985436. 6. Chaudhari R.N. Waves and Oscillations, New Age International (Pvt.) Ltd.New Delhi, 2nd edition, ISBN 13 – 978812242842. 7. Taggarase A. P., JivanSheshan. Conceptual Physics, Himalaya Publishing.	

	8. Bajaj N. K. 1988, The Physics of Waves and Oscillations, Tata McGraw Hill. ISBN–0074516108, 9780074516102. 9. Agarwal B. S..Oscillations and Waves, KedarNath, Ram Nath Publishers ISBN–1234567146749. 10. Mee and Heinmann. 1967 Sound, London Edition 2nd Edition.	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-242: Optics

Total Hours: 30 **Credits: 2**

Course Objectives	• To impart knowledge of basic concepts in Optics. • To describe the principles of interference and its applications • To study phenomenon of diffraction. • To study phenomenon of polarization and its applications	
Course outcomes	After the completion of this course Students will be able to…. • Apply the optics using different geometrical shapes. • Understand the idea of various kinds of polarization of light wave and their detection. • Study Fraunhofer and Fresnel diffraction. • Clear the idea of spatial and temporal coherence for the formation of interference fringes. • Describe the operation of optical devices including, polarisers, retarders and interferometers.	
Unit	**Topic Particular**	**Hours**
Unit I	**Geometrical Optics:** • The nature of light, Images by Reflection, Refraction, Dispersion, Snell's law, Lenses Deviation produced by thin lenses, equivalent focal length of two thin lenses separated by a distance and when in contact. • Power of lens, Spherical aberration in lens, chromatic aberration, reduction of spherical aberration.	**7**
Unit II	**Interference:** • Review of some concepts in optics, concept of interference of light, intensity distribution in the interference pattern, expression for fringe width • Youngs double slit experiment, Fresnel biprism, Stoke's treatment, Interference due to thin film, Newton's ring experiment, Principle construction and working of Michelson interferometer, Applications of Michelson Interferometer.	**8**
Unit III	**Diffraction:** • Definition, difference between interference and diffraction, types of diffraction Fresnel's diffraction, Derivation of radius of HPZ : i] Diffraction at straight edge ii] Diffraction at single slit, • Fraunhoffer's Diffraction : Diffraction through Single slit, double slit and grating, Resolving power of microscopes, Dispersive and resolving power of grating	**7**
Unit IV	**Polarization:** • Experiment to determine transverse nature of light.Polarization : polarized and unpolarized light, types of polarization, basic phenomenon of polarization : 1) polarization by reflection 2) polarization by refraction 3) polarization by scattering, • Brewster's law, Malus law, Huygen's explanation of double refraction in uniaxial crystal, Nicol prism, Optical Activity, optical rotation, specific rotation, Polarimeter.	**8**

References	• Hetch E., GanesanA.R.. Optics, fourth edition, Pearson education, • Subhramanyam N., Brijlal, Avadhanulu M. N..A Text book of Optics, S. Chand publication. • Ghatak A. K. Physical Optics, McMillan, New Delhi. • Jenkins F. A., White H. E. Fundamentals of Optics, McGraw- Hill international Edition. 10 • E. Hetch, A.R. Ganesan. 2008 Optics, fourth edition, Pearson education, 4th edition, ISBN 10- 8131718077 , ISBN 13 - 9788131718070 • Subhramanyam N., Brijlal, Avadhanulu M. N. A Text book of Optics, S. Chand publication. ISBN - 9788121926119 • Ghatak A. K. Physical Optics, McMillan, New Delhi. ISBN - 9781259004346 • Jenkins F. A., White H. E. 1957Fundamentals of Optics, McGraw- Hill international Edition. • Mathur D. S. 1999 Principles of optics, Gopal Press, Kanpur, 7TH edition	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-243: Practicals on Waves and Oscillations, Optics I

Total Hours: 60 **Credits: 2**

Course Objectives	• To give hands on training on Waves and oscillations experiments. • To study resonance using different methods. • To verify different phenomenon in sound and light wave experiments using Doppler effect. • To study types of damping in the waves motion.	
Course Outcomes	After the completion of this course Students will be able to…. • Understand and verify the practical aspects of waves and oscillation. • Calculate different coefficients/constants with damping or resonance. • Comprehend the relation between theory and practical observations of Lissajous figures. • Measure actual velocity of sound using experimental kits.	
Sr. No.	**Topic Particular**	**Hours**
1	To understand the applications of CRO by measuring voltage, frequency and phase of a of different waveforms using CRO.	
2	To study Lissajous Figures and demonstration of Lissajous figures by using C.R.O.	4
3	To investigate the motion of coupled oscillators	4
4	Study of acoustic resonance by using bottle as a resonator.	4
5	To study Log decrement.	4
6	Study of resonance using Kater's pendulum.	4
7	To calculate Damping coefficient.	4
8	To determine the electrical resonance frequency using LCR circuit.	4
9	To determine the Frequency of an Electrically Maintained Tuning Fork by Melde's experiment and to verify $\lambda 2 - T$ Law.	4
10	Determination of velocity of sound by using Kundt's tube.	4
11	To visualize sound waves using Tonoscope.	4
12	To measure the speed of sound wave in air.	4
13	To study the existence of Electromagnetic waves using Hertz experiment.	4
14	To study the Doppler effect in sound/light waves.	4
15	To study the arrangement and alingnment of Spectroscope by Schutsters method	4
16	To determine the Resolving Power of a Prism.	4
17	To determine the value of Cauchy Constants of a material of a prism.	4
18	To determine wavelength of sodium light using Fresnel Biprism	4
19	To determine wavelength of sodium light using Newton's Rings.	4
20	To determine wavelength of Sodium light using plane diffracBtion Grating	4

References	• Advanced Practical Physics for students, B. L. Flint and H. T. Worsnop, 1971, Asia Publishing House. • Engineering Practical Physics, S. Panigrahi and B. Mallick, 2015, Cengage Learning India Pvt. Ltd. • Practical Physics, G. L. Squires, 2015, 4/e, Cambridge University Press. • A Text Book of Practical Physics, Vol I and II, Prakash and Ramakrishna, 11/e, 2011, KitabMahal. • An Introduction to Error Analysis: The study of uncertainties in Physical Measurements, J. R. Taylor, 1997, University Science Books List of experiments. • Flint B.L. &Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. 2 nd edition. • Michael Nelson and Jon M. Ogborn. Advanced level Physics Practicals, 4th Edition, reprinted 1985, Heinemann Educational Publishers. • InduPrakash and Ramakrishna (2011) A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. • Arora C. L. B.Sc. Practical Physics, S. Chand Publishing Co. Ltd., New Delhi, ISBN – 9788121909099.	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-DSC-244: Practicals on Waves and Oscillations, Optics II

Total Hours: 60 **Credits: 2**

Course Objectives	• To give hands on training on Waves and oscillations experiments • To give hands on training on sound and light experiments	
Course Outcomes	After the completion of this course Students will be able to…. • To demonstrate their practical skills. • To understand and practice the skills while doing physics practical. • To understand the use of apparatus and their use without fear. • To correlate their physics theory concepts through practical. • Understand and verify the practical aspects of Waves and oscillations, sound and light.	
Sr. No.	**Topic Particular**	**Hours**
1	To determine the value of g using bar pendulum.	4
2	To determine the value of acceleration due to gravity using Kater's pendulum for both the cases (a)$T_1 \approx T_2$ and (b) $T_1 \neq T_2$ and discuss the relative merits of both cases by estimation of error in the two cases.	4
3	To study the Directional characteristics of a microphone	4
4	To determine Velocity of sound by phase shift method	4
5	Study of acoustic resonance by using resonance tube.	4
6	Study of Oscillations under Bifilar suspension.	4
7	To determine the refractive index of a liquid by using Newton's rings apparatus.	4
8	Determination of specific rotation α of optically active substance using Polarimeter.	4
9	To determine wavelength of spectrum of Mercury light using plane diffraction Grating	4
10	To determine the Resolving Power of a Plane Diffraction Grating.	
11	To measure the intensity using photo sensor and laser in diffraction patterns of single and double slits.	4
12	To determine the Dispersive Power of a Prism.	4
13	To determine the Dispersive Power of a Plane Diffraction Grating.	4
References	• Flint B.L. &Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. 2 nd edition • Michael Nelson and Jon M. Ogborn. Advanced level Physics Practicals, 4th Edition, reprinted 1985, Heinemann Educational Publishers • InduPrakash and Ramakrishna (2011) A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. • Arora C. L. B.Sc. Practical Physics, S. Chand Publishing Co. Ltd., New Delhi, ISBN - 9788121909099	

S.Y. B.Sc. Physics (Minor)
Semester-IV
PHY-MIN-241: Modern Physics

Total Hours: 30 **Credits: 2**

Course Objectives	• This course covers certain conceptual courses of physics by virtue of which the students will be able to understand some concepts of Quantum Mechanics, Atomic Physics and Nuclear Physics. • It also imparts the basic principles of Quantum mechanics, Schrodinger equation and its applications • To introduce students to the fundamentals of atomic physics and nuclear physics. • To introduce them to the basic Laser principles and Properties.	
Course outcomes	After the completion of this course Students will be able to…. • Understand and explain the differences between classical and quantum mechanics. • Understand properties of the nucleus and other sub-atomic particles. • Understand structure of atoms and the origin of the observed spectra. • Understand the construction and working of different Laser used and makes a comparison between them.	
Unit	**Topic Particular**	**Hours**
Unit I	**Radiation and its nature** • Black body Radiation, Planck's quantum hypothesis, Planck's constant. Photoelectric effect and Compton scattering - light as a collection of photons. Davisson-Germer experiment. • De Broglie wavelength and matter waves.Wave-particle duality.Wave description of particles by wave packets. • Group and Phase velocities and relation between them. Heisenberg uncertainty principle with illustration.	**08**
Unit II	**The Structure of the Atoms** • Alpha-particle Scattering and Rutherford's Nuclear Model of Atom, Atomic Spectra, Bohr Model of the Hydrogen Atom, Failure of Bohr Model • Energy level diagram of hydrogen atom.The correspondence principle, Frank and Hertz Experiments	**07**
Unit III	**Nuclei and its properties** • Atomic Masses and Composition of Nucleus,Size of the Nucleus, Discovery of Neutron, Classification of nucleus,Mass defect and Binding Energy • Nuclear Force and its properties, Radioactivity (Definition, Types of Radiation and its Properties, Half-life, Mean life and Applications), Nuclear Energy (Nuclear Fission and Nuclear fusion)	**08**
Unit IV	**Laser and its application** • Einstein's A and B coefficients, Metastable states, Spontaneous and Stimulated emissions, Optical Pumping and Population Inversion. • Three-Level and Four-Level Lasers, Ruby Laser and He- Ne Laser, Basic lasing action and application of laser.	**07**
References	1. Concepts of Modern Physics, Arthur Beiser, 2002, McGraw-Hill. 2. Refresher course in B. Sc Physics Vol I and Vol III, C. L. Arora, 2010, S. Chand Publishers. 3. Introduction to Modern Physics, Rich Meyer, Kennard, Coop, 2002, Tata McGraw Hill 4. Introduction to Quantum Mechanics, David J. Griffith, 2005, Pearson Education. 5. Modern Physics, G.Kaur and G.R. Pickrell, 2014, McGraw Hill	

	6. Quantum Mechanics: Theory & Applications, A.K.Ghatak&S.Lokanathan, 2004, Macmillan 7. Modern Physics, J.R. Taylor, C.D. Zafiratos, M.A. Dubson, 2004, PHI Learning. 8. Theory and Problems of Modern Physics, Schaum`s outline, R. Gautreau and W. Savin, 2ndEdn, Tata McGraw-Hill Publishing Co. Ltd. 9. Quantum Physics, Berkeley Physics, Vol.4. E.H.Wichman, 1971, Tata McGraw-Hill Co. Physics for scientists and Engineers with Modern Physics, Jewett and Serway, 2010, Cengage Learning.	

S.Y. B.Sc. Physics (Minor)
Semester-IV
PHY-MIN-242: Practicals on Modern Physics

Total Hours: 60 **Credits: 2**

Course Objectives	• To provide practical knowledge in quantum physics, atomic physics, nuclear physics and lasers. • To understand the practicals on quantum physics, atomic physics, nuclear physics and lasers. • To develop an ability to handle various instruments like GM tube, laser, photoelectric cell, Frank Hertz experiment, etc. • To develop the experimental skills of students.	
Course Outcomes	After the completion of this course Students will be able to…. • Understand the concept of quantum physics, atomic physics, nuclear physics and lasers practically. • Know about the instruments like GM tube, laser, photoelectric cell, Frank Hertz experiment, etc. • Able to handle the various instruments in Laboratory. • Adequate knowledge of the instruments.	
Sr. No.	**Topic Particular**	**Hours**
1	To determine the diameter of wire by diffraction method using He-Ne laser.	4
2	To determine the value of e/m by (a) Magnetic focusing or (b) Bar magnet.	4
3	To determine the wavelength of laser source using diffraction of single slit.	4
4	To determine the wavelength of laser source using diffraction of double slits.	4
5	To determine (1) wavelength and (2) angular spread of He-Ne laser using plane diffraction grating	4
6	To verify the Heisenberg's Uncertainty principle using laser.	4
7	To study the characteristics of GM tube.	4
8	To study the determination of beta particle range and maximum energy by half thickness method.	4
9	To determine linear absorption coefficient and mass absorption coefficient of Al by GM tube.	4
10	To determine the wavelength of the spectral lines of hydrogen and also determine Reydberg's constant.	4
11	To determine the value of Plank's constant using photocell.	4
12	To demonstrate the concept of quantization of the energy levels of an atom.	4
13	Measurements of the h/e Ratio and the Work Function.	4
14	To determine the thickness of engraved scale by diffraction using laser.	4
15	To determine the dead time of a given G.M. tube using double source.	4
16	To draw the plateau curve for a Geiger Muller counter.	4
17	To find the half-life period of a given radioactive substance using a G.M. Counter.	4

18	To determine the value of e/m for electron by long solenoid method.	4
19	Measurement of Planck's constant using black body radiation and photo-detector	4
20	Photo-electric effect: photo current versus intensity and wavelength of light; maximum energy of photo-electrons versus frequency of light	4
21	To determine the Planck's constant using LEDs of at least 4 different colors.	4
22	To verify the inverse square law of radiation using a photo-electric cell.	4
References	• Advanced Practical Physics for students, B.L. Flint and H.T. Worsnop, 1971, Asia Publishing House. • Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers. • A Text Book of Practical Physics, I. Prakash& Ramakrishna, 11th Edn, 2011,Kitab Mahal • Advanced level Physics Practicals, Michael Nelson and Jon M. Ogborn, 4th Edition, reprinted 1985, Heinemann Educational Publishers • A Text Book of Practical Physics, I.Prakash& Ramakrishna, 11thEdn, 2011,Kitab Mahal	

S.Y. B.Sc. Physics (Open Elective)
Semester-IV
PHY-OE-241: Solar Cell Technologies

Total Hours: 30 **Credits: 2**

Course Objectives	• This syllabus is design to provide basic knowledge of solar cell. • It gives students detail information of energy generation from solar cell. • To understand the applications of solar energy for different purposes i.e Energy genarations, energy conversion, energy storage, etc • Get knowledge of fundamentals of solar cells, I-V characteristics solar cell parameters, conversion efficiency and power output of solar cell.	
Course outcomes	After the completion of this course Students will be able to…. • Get familiar with basic principles of solar technology & solar photovoltaic cells. • Learn about solar radiation, solar spectrum, optimal tilt for solar equipment, monthly averaged global radiation etc. • Understand the grid connections with solar plants and may help in further studies for solar panel installation. • It will provide an opportunities to start the business or startup related to solar panel, Batteries and storage technologies.	
Unit	**Topic Particular**	**Hours**
Unit I	**Solar Radiation** • Introduction, Issues concerning the use of the conventional energy sources, renewable energy and its role in energy supply spectral energy distribution of solar radiation. • Depletion of solar radiation - Absorption, scattering, atmospheric attenuation, Measurement of solar radiation, Solar radiation geometry, Calculation of angle of incidence, Calculation of total solar radiation on horizontal and tilted surfaces. Angles for tracking surfaces.	**8**
Unit II	**Introduction to Solar Cell** • Rolar radiation to electrical energy conversion, semiconductors, p-n junction, semiconductor properties, energy levels, basic equations, • Basic structure of a solar cell, current-voltage characteristics, equivalent circuit, fill factor, efficiency, power curve, maximum power point	**7**
Unit III	**Types of Solar Cells** • classification of solar cells- single crystalline silicon cells, multi crystalline silicon cells, amorphous silicon, cadmium telluride, copper indium gallium di selenide cells. • Organic and Dye synthesized solar cells. Difference between thick and thin film solar cells. Optical, ohmic and recombination losses in solar cells, measures for improving efficiency.	**7**
Unit IV	**Module Performance and Design of Small PV Systems** • Solar cell, module, panel and array, series and parallel connection of solar cells, I-V characteristics of a PV module, maximum power point, cell efficiency, fill factor, effect of irradiation and temperature on performance of PV panel. • Design of solar PV lantern,stand alone PV system- Home lighting and other appliances, solar water pumping systems.	**8**
References	1. Foster R., Ghassemi M., Cota A., “Solar Energy”, CRC Press, 2010. 2. Duffie J.A., Beckman W.A. “Solar Engineering of Thermal Processes”, 3rd ed., Wiley, 2006. 3. De Vos, A., “Thermodynamics of Solar Energy Conversion”,WileyVCH, 2008. 4. Garg H.P., Prakash J., “Solar Energy Fundamentals and Applications”, Tata McGraw-Hill, 2005.	

5. Kalogirou S., “Solar Energy Engineering”, Processes and Systems, Elsevier, 2009.
6. Petela, R., “Engineering Thermodynamics of Thermal Radiation for Solar Power”, McGraw-Hill Co., 2010.
7. Yogi Goswami D., Frank Kreith, Jan F. Kreider, “Principles of Solar Engineering”, Second Edition, Taylor & Francis, 2003.
8. Andrews J., Jelley N., “Energy Science”, Oxford University Press, 2010.
9. Vogel W., Kalb H., “Large-Scale Solar Thermal Power Technologies”, Wiley-VCH, 2010.
10. Khartchenko N.V., “Green Power: Eco-Friendly Energy Engineering”, Tech Books, Delhi, 2004.
11. Goswami D.Y., Kreith F., Kreider J.F., “Principles of Solar Engineering”, 2nd ed., Taylor and Francis, 2000, Indian reprint, 2003.
12. Laughton C., “Solar Domestic Water Heating”, Earthscan, 2010. 8. Yannas S., Erell E., Molina J., Roof Cooling Techniques: Design Handbook, Earthscan, 2006.
13. K.Sukhatme, SuhasP.Sukhatme., “Solar energy: Principles of thermal collection and storage”, Tata McGraw Hill publishing Co. Ltd, 8th edition, 2008.

S.Y. B.Sc. Physics (Open Elective)
Semester-IV
PHY-OE-242: Practicals on Solar Cell Technologies

Total Hours: 60 **Credits: 2**

Course Objectives	• To develop an awareness of the importance of accurate examination in the understanding of solar energy. • Understand the analysis of various parameter from grid connected solar plant. • To Understand and work on solar PV system for energy storage. • To develop the student practical and technical skills required for solar panel technology.	
Course Outcomes	After the completion of this course Students will be able to…. • Understand and verify the practical aspects of solar cell technologies. • Understand the various parameter of solar cell by these experiment. • Understand the grid connections with solar plants and may help in further studies for solar panel installation. • It will provide an opportunities to start the business or startup related to solar panel, Batteries and storage technologies.	
Sr. No.	**TopicParticular**	**Hours**
1	To study about the configuration of solar PV system.	4
2	To plot the V-I characteristics of solar PV system.	4
3	To plot the power characteristics of solar PV system.	4
4	To analyze the effect of temperature on solar output voltage and current.	4
5	To analyze the effect of temperature on solar output power.	4
6	To study the operation of battery charge using a PV module	4
7	To study the effect of partial shading on PV panel operation.	4
8	To plot solar panel performance versus insolation.	4
9	To study sun tracking system in solar panels.	4
10	To take readings of various parameters from a grid connected solar plant.	4
11	To determine fill factor and efficiency of solar cell.	4
12	Comparison of luminous intensities of two light sources by using photo voltaic cell.	4
13	To determine work function of material of cathode using photocell.	4
14	To study intensity response of photocell and verify inverse square law of radiation.	4
15	To compare the conversion efficiency of Monocrystalline and Poly crystalline Solar	4
16	To study series and shunt resistance of solar cell.	4

References	1. Flint B.L.&Worsnop H.T. (1971). Advanced Practical Physics for students, Asia Publishing House. New Delhi 2. Michael Nelson and Jon M. Ogborn. Advanced level Physics Practicals, 4th Edition, reprinted 1985, Heinemann Educational Publishers 3. InduPrakash and Ramakrishna (2011). A Text Book of Practical Physics, 11th Edition, KitabMahal, New Delhi. 4. Khandelwal D.P. (1985). A Laboratory Manual of Physics for Undergraduate Classes, Vani Publication. New Delhi	

S.Y. B.Sc. Physics (Major)
Semester-IV
PHY-FP-241: Field Project

Contact hours: 60 **Credits: 2**

Preamble

In alignment with the National Education Policy (NEP) 2020, Moolji Jaitha College (Autonomous), Jalgaon is introducing the Field Project at the undergraduate level. The NEP 2020 emphasizes holistic development, inclusivity, and integrating vocational education with academic learning, aiming to nurture socially responsible individuals. This course fosters a strong connection between education and real-world applications. These initiatives aim to bridge the gap between theoretical knowledge and practical experience, helping students develop critical thinking, problem-solving skills, and a sense of civic responsibility.

Objectives

- To provide students with practical exposure in rural and urbansocioeconomic context.
- To develop students abilities to apply subject knowledge to address real world problems
- To foster critical thinking and innovative approaches to solve socioeconomic issues.

Outcomes

After completing this course, students will be able to

- Participateactively in filed projects that benefit local communities and promote sustainable development practices.
- Analyse the socio economic data using appropriate methods showcasing improved problem-solving skills, technical proficiency.
- Demonstrate the ability to apply theoretical knowledge to real-world situations effectively and exhibit communication skills.

Course structure

The course is divided in to four probable phases

I] Orientation and preparation

- Introduce to the course, objectives and expectation
- Overview of socioeconomic development issues in rural and urban context
- Training on working methodology and data collection techniques
- Review existing literature related to topic to understand the background and context.

II] Workplanand Field visit

- Visit the potential sites to get a sense of the environment and logistical requirements.
- Create a detailed project plan outlining the steps, timeline, resources needed, and roles of team members.
- Obtain necessary approvals (Ethical/ local authorities/organizations/communities)
- Gather materials and resources (recording devices, cameras, notebooks and supplies)
- Conduct Preliminary Survey, choose appropriate methods for data collection and analysis (e.g., surveys, interviews, observations).

III] Data collection and analysis

- Pilot test to identify issues with data collection.
- Collect data systematically, ensuring consistency and accuracy.
- Keep detailed records of all data (field notes, recordings, photographs etc)
- Organize and analyse the data (manual/ software)

IV] Interpretation and Reporting

- Interpret your findings in the context to objectives.
- Write and submit a comprehensive report detailing your methodology, findings, analysis, and conclusions. (Include visuals - charts, graphs, and photographs).
- Prepare a presentation to share findings with peers/ instructors/ community.

Assessment

- Field work participation, field note book, team work etc. (10 Marks)
- Data Collection and Analysis (15 Marks)
- Field project report (15 Marks)
- Presentation of Findings(10 Marks)

Examples of activities to be conducted under field projects

- **Biodiversity Survey**: Conduct a biodiversity survey in a local park or nature reserve, documenting plant and animal species.
- **Water Quality Testing**: Test water samples from different sources (e.g., rivers, lakes, groundwater) for pollutants and compare results.
- **Soil Analysis**: Collect soil samples from various locations and analyse their composition and quality.
- **Wildlife Tracking**: Use camera traps or tracking devices to monitor and study the behaviour of local wildlife.
- **Urban Heat Island Effect**: Measure and map temperature differences in various parts of a city.
- **Land Use Mapping**: Create maps showing different land uses in a region and analyze changes over time.
- **Cultural Heritage Documentation**: Document and analyze local cultural heritage sites or practices.
- **Community Interviews**: Conduct interviews with community members to understand social dynamics and traditions.
- **Ethnographic Study**: Participate in and observe community events to gather ethnographic data.
- **Crop Yield Analysis**: Study the factors affecting crop yield in different fields or under different farming practices.
- **Pest Management**: Investigate the effectiveness of various pest management techniques in local farms.
- **Sustainable Farming Practices**: Evaluate the impact of sustainable farming practices on soil health and crop productivity.
- **Community Needs Assessment**: Conduct surveys and interviews to identify the needs and concerns of a community.
- **Social Network Analysis**: Study the social networks within a community to understand relationships and influence.
- **Public Health Study**: Investigate public health issues in a community, such as access to healthcare or prevalence of diseases.
- **Infrastructure Survey**: Assess the condition and effectiveness of local infrastructure, such as roads, bridges, and buildings.
- **Renewable Energy Potential**: Evaluate the potential for renewable energy sources (e.g., solar, wind) in a specific area.
- **Water Management**: Study and improve local water management systems, including irrigation and drainage.
- **Literacy Program Evaluation**: Evaluate the effectiveness of local literacy programs and suggest improvements.
- **Educational Resource Assessment**: Assess the availability and quality of educational resources in local schools.
- **Market Analysis**: Conduct a market analysis for a local business or industry.
- **Entrepreneurship Project**: Develop a business plan for a local entrepreneurial venture
- **Local History Documentation**: Research and document the history of a local site, building, or community.
- **Oral History Project**: Conduct interviews with local residents to collect oral histories and preserve community memories.
- **Archival Research**: Explore local archives to uncover historical documents and artifacts related to a specific topic or period.
- **Community Mural**: Design and create a mural in collaboration with community members that reflects local culture and history.
- **Public Art Installation**: Develop and install a public art project that engages the local community.

- **Art Exhibit Curation**: Curate an exhibit featuring works by local artists, highlighting themes relevant to the community.
- **Music Documentation**: Record and document traditional or contemporary music from the local area.
- **Community Concerts**: Organize and perform in community concerts that showcase local musical talent.
- **Community Theatre Production**: Develop and produce a play that involves community members as actors and crew.
- **Site-Specific Theatre**: Create a theatrical performance that takes place in a non-traditional venue, such as a historic site or public space.
- **Cultural Mapping**: Map cultural resources and heritage sites within the community and analyze their significance.
- **Festival Documentation**: Document and analyze local festivals or cultural events, exploring their history and impact.
- **Ethnographic Study**: Conduct an ethnographic study of a particular cultural practice or community group.
- **Public Philosophy Discussions**: Organize and facilitate public discussions on philosophical topics relevant to the community.
- **Community Documentary**: Create a documentary film about a local issue, event, or group.
- **Digital Storytelling**: Develop digital storytelling projects that capture and share local stories.
- **Language Survey**: Conduct a survey of languages spoken in the community and analyze patterns of language use and change.
- **Dialect Study**: Study and document local dialects or accents, exploring their features and origins.
- **Language Preservation**: Work with community members to document and preserve endangered languages or dialects.
- **Gentrification Impact Study**: Examine the effects of gentrification on local communities, including displacement and economic changes.
- **Crime and Safety Analysis**: Study crime patterns and perceptions of safety within a community.
- **Ritual and Festival Study**: Participate in and document local rituals or festivals to understand their social and cultural significance.
- **Migration Patterns Study**: Analyze migration patterns and their effects on both the sending and receiving communities.
- **Food and Culture Study**: Investigate the role of food in cultural practices and social interactions within a community.
- **Local Governance Analysis**: Study the structure and functioning of local government and its impact on the community.
- **Political Participation Study**: Analyze patterns of political participation and engagement within a community.
- **Public Policy Impact Assessment**: Evaluate the impact of specific public policies on local communities.
- **Election Study**: Analyze voting behavior and patterns in local elections.
- **Mental Health Survey**: Conduct surveys to assess the mental health needs and resources in a community.
- **Social Behavior Observation**: Observe and analyze social behaviors in public spaces, such as parks or markets.
- **Stress and Coping Study**: Investigate sources of stress and coping mechanisms within a community.
- **Community Support Systems**: Study the role and effectiveness of community support systems and networks.
- **Youth Development Programs**: Evaluate the impact of youth development programs on community wellbeing.
- **Educational Equity Study**: Assess disparities in educational resources and outcomes in local schools.
- **Parent and Teacher Interviews**: Conduct interviews to understand perceptions of educational quality and challenges.
- **After-School Program Evaluation**: Evaluate the effectiveness of after-school programs in supporting student development.
- **Educational Attainment Study**: Analyze factors influencing educational attainment in a community.
- **Local Economy Analysis**: Study the structure and dynamics of the local economy, including key industries and employment patterns.
- **Small Business Survey**: Conduct surveys of local small businesses to understand their challenges and successes.
- **Economic Impact of Events**: Analyze the economic impact of local events or festivals on the community.

- **Income Inequality Study**: Investigate patterns and causes of income inequality within a community.
- **Housing Affordability Analysis**: Study housing affordability issues and their impact on residents.
- **Gender Roles and Expectations**: Study gender roles and expectations within a community and their impact on individuals.
- **Women's Health Study**: Investigate issues related to women's health and access to healthcare.
- **Gender-Based Violence Survey**: Conduct surveys to understand the prevalence and impact of gender-based violence.
- **Workplace Equality Study**: Analyze gender equality in local workplaces, including pay equity and job opportunities.
- **Urban Development Projects**: Study the impact of urban development projects on local communities.
- **Public Space Usage**: Analyze how public spaces are used and perceived by different community members.
- **Transportation Study**: Investigate transportation needs and challenges within a community.
- **Green Space Analysis**: Study the availability and usage of green spaces in urban areas and their impact on residents.