CURRICULUM & SYLLABI

4- year Integrated B.Sc. B.Ed.

Effective from AY: 2024-25

NATIONAL INSTITUTE OF TECHNOLOGY WARANGAL

WARANGAL, TELANGANA

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Vision and Mission of the Institute
National Institute of Technology Warangal

VISION
Towards a Global Knowledge Hub, striving continuously in pursuit of excellence in Education, Research, Entrepreneurship, and Technological services to society

MISSION
- Imparting total quality education to develop innovative, entrepreneurial, and ethical future professionals fit for a globally competitive environment.
- Allowing stake holders to share our reservoir of experience in education and knowledge for mutual enrichment in the field of technical education.
- Fostering product-oriented research for establishing a self-sustaining and wealth-creating centre to serve the societal needs.

Vision and Mission of the Department

EDUCATION

VISION
To be an innovative hub for teacher education by preparing skilled, ethical, learner-centered, and humane educators who emphasize equity and excellence, integrate strong disciplinary knowledge with innovative pedagogical practices, and contribute meaningfully to quality teaching and learning that promotes learners' lifelong success

MISSION

- ❖ To promote experiential, competency-based, and learner-centred teaching–learning practices with professional pedagogical knowledge supported by continuous and comprehensive assessment, curriculum design, and educational technology.
- ❖ To develop high-quality student-teachers equipped with critical thinking, creativity, communication, collaboration, digital literacy and to integrate and apply ICT in facilitating the teaching-learning process and in school management.
- ❖ To Inculcate ethical values, inclusivity, and social responsibility to nurture educators committed to equity and national development.
- ❖ Encourage lifelong learning and continuous professional development, enabling educators to adapt to evolving educational policies, technologies, and societal needs.

B. Sc. B. Ed. (Secondary Stage with Major in Mathematics / Physical Sciences)

Program Educational Objectives (PEO)

PEO-1	Provide sufficient understanding of individual and group motivation and behavior to establish a learning environment that promotes positive social interaction, critical thinking, problem-solving, performance skills, and active participation in learning and self-motivation.
PEO-2	Facilitate as a deep learner and progressive careers in teaching, academia, and research organizations,
PEO-3	Communicate effectively with school colleagues, parents, and agencies in the larger community to support students, learning, and well-being.
PEO-4	Assess the learner's continuous intellectual, social, and physical development using formal and informal assessment strategies.
PEO-5	Engage in lifelong learning and career enhancement and adapt to changing professional and societal needs.

Program Articulation Matrix

PEO / Mission Statements	PEO1	PEO2	PEO3	PEO4	PEO5
To promote experiential, competency-based, and learner-centered teaching–learning practices with professional pedagogical knowledge supported by continuous and comprehensive assessment, curriculum design, and educational technology.	2	3	2	3	2
To develop high-quality student-teachers equipped with critical thinking, creativity, communication, collaboration, digital literacy and to integrate and apply ICT in facilitating the teaching-learning process and in school management.	3	3	3	2	2
To Inculcate ethical values, inclusivity, and social responsibility to nurture educators committed to equity and national development.	2	3	2	2	2
Encourage lifelong learning and continuous professional development, enabling educators to adapt to evolving educational policies, technologies, and societal needs..	3	2	3	3	3

1-Slightly; 2-Moderately; 3-Substantial

Program: B.Sc.B.Ed
(Secondary Stage with Major in Mathematics / Physical Sciences)
Program Outcomes (PO)

PO1	Develop knowledge and understanding with a solid foundation in educational views and the ability to build a logical conceptualization of pedagogical knowledge that they would apply to specific curriculum areas.
PO2	Understand the role of education and schools in promoting sustainable development; critically analyze various theoretical perspectives on education, teaching, assessment, and learning in the light of the learner's nature and diversity.
PO3	**Design/Development of solutions:** Design solutions for complex learners' behavior and learning environment and design tools or processes that meet the specified needs with appropriate consideration for public health and safety and the cultural, societal, and environmental considerations
PO4	Able to integrate theoretical and practical knowledge of their respective subject(s) in classroom practices, as well as pursue to keep themselves up to date with advancements in their areas of specialization, to demonstrate their commitment to continuous self-improvement by engaging in professional development activities, reflective practices to improve teaching and learning, and to contribute to the revitalization of the teaching profession
PO5	**Modern tool usage:** Create, select, and apply appropriate techniques, resources, ICT, and media communication techniques, including prediction and modeling, to complex teaching-learning activities with an understanding of the limitations.
PO6	**The engineer and society:** Apply reasoning informed by contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional learning practice.
PO7	**Environment and sustainability** Understand the impact of education technology in societal and environmental contexts and demonstrate the knowledge of and need for sustainable development.
PO8	Acquire a wide range of key life skills and abilities in communication, reflection, art, aesthetics, theatre, Yoga, and teaching skills needed for planning and organizing inclusive education and effective whole-classroom instruction.
PO9	Develop an ability to substantiate perspectives and pedagogical content studied with field-based experiences provided during pre-internship, school internship, and post-internship; adapt to cater to the diverse needs of learners in schools; understand and experience the real world of teaching with the help of systematic supervisory support and feedback.
PO10	**Communication**: Communicate effectively about teaching and learning activities with the students, parents, and other professionals involved in the learning, such as comprehending and writing effective reports and design documentation, making effective presentations, and giving and receiving clear instructions.
PO11	**Project management and finance** Demonstrate knowledge and understanding of engineering and management principles and apply these to one's work as a member and leader in a team, to manage projects, and in multidisciplinary environments.
PO12	**Life-long learning**: Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

Program Specific Outcomes (PSO)

PSO1	Understand basic concepts and ideas of educational theory about teaching, pedagogy, school management, and community involvement.
PSO2	Develop a broad theoretical foundation in mathematics/physical sciences and a perspective on the nature of the learner, diversity, and learning. Design and develop interfaces among subsystems of learning.
PSO3	Comprehend the role of the governance systems and structural-functional provisions that support school education.
PSO4	Build skills and abilities in communication, reflection, art, aesthetics, theatre, self-expression, and ICT.

CURRICULUM
B. Sc. B. Ed. (Secondary Stage with Major in Mathematics / Physical Sciences)

1st Semester

SNo	Code	Course Title		L	T	P	Credits
1	HS3101	Language 1 (Sanskrit)		3	1	0	4
2	ED3101	Understanding India (Indian Ethos and Knowledge Systems)		2	0	0	2
3	ED3103	Art Education (Performing and Visual)		1	0	2	2
4	ED3105	Evolution of Indian Education		3	1	0	4
		Mathematics Major	**Physical Sciences Major**				
5	MA3101	Differential and Integral Calculus	Differential and Integral Calculus **(Minor)**	3	1	0	4
6	MA3103/ PH3101	Python Programming ***(Minor)***	Mechanics, Waves, and Oscillations	3	0	2	4
8	MNC01	Extra Academic Activity – I		0	0	0	0
			Total	**15**	**3**	**4**	**20**

2nd Semester

Sl No	Course Code	Course Title		L	T	P	Credits
1	HS3102	Language - II (Communicative English)		3	0	2	4
2	ED3102	Understanding India (Indian Ethos and Knowledge Systems)		2	0	0	2
3	ED3104	Teacher and Society		2	0	0	2
		Mathematics Major	**Physical Sciences Major**				
4	MA3102	Elementary Ordinary Differential Equations	Elementary Ordinary Differential Equations **(Minor)**	3	1	0	4
5	MA3104/ PH3102	Analytic Solid Geometry	Heat and Thermodynamics	3 3	1 0	0 2	4
6	MA3106/ CY3102	Computer Programming with C ***(Minor)***	Organic Chemistry – I	3	0	2	4
7	MNC02	Extra Academic Activity – II		0	0	0	0
			Total	**16**	**2/1**	**4/6**	**20**

3rd Semester

S No	Code	Course Title		L	T	P	Credits
1	ED3201	Child Development and Educational Psychology		3	1	0	4
2	ED3203	Basics of Pedagogy at the Secondary Stage		3	1	0	4
		Mathematics Major	**Physical Sciences Major**				
3	MA3201	Modern Algebra	Modern Algebra ***(Minor)***	3	1	0	4
4	MA3203/ PH3201	Numerical Analysis	Optics	3 3	1 0	0 2	4
5	MA3205 CY3201	Data Structures with C ***(Minor)***	Inorganic Chemistry-1	3	0	2	4
			Total	**15**	**4/3**	**2/4**	**20**

4th Semester

Sl No	Code	Course Title		L	T	P	Credits
1	ED3202	Philosophical & Sociological Perspectives of Education-I		3	1	0	4
		Mathematics Major	**Physical Sciences Major**				
2	ED3204/ ED3206	Content cum Pedagogy of Math at Secondary Stage–I	Content cum Pedagogy of Physical Sciences at Secondary Stage - I	3	0	2	4
3	MA3202	Linear Algebra	Linear Algebra ***(Minor)***	3	1	0	4
4	MA3204/ PH3202	Digital Computer Fundamentals ***(Minor)***	Electricity and Magnetism	3	0	2	4
5	MA…. / CY3202	Mathematics Major: Elective – I	Physical Chemstry-1	3 3	1 0	0 2	4
			Total	**15**	**3/2**	**4/6**	**20**

5th Semester

Sl No	Code	Course Title		L	T	P	Credits
		Mathematics Major	Physical Sciences Major				
1	ED3301/ ED3303	Content cum Pedagogy of Math at Secondary Stage–II	Content cum Pedagogy of Physical Sciences at Secondary Stage - II	3	1	0	4
2	MA3301/ CY3301	Mathematical Analysis	Physical Chemistry - 2	3	0	2	4
3	MA3303/ CY3303	Linear Programming & Applications	Inorganic Chemistry-2	3 3	1 0	0 2	4
4	PH3301	Basic Electronics	Basic Electronics	3	0	2	4
5	ED3305	ICT in Education		2	0	0	2
6	ED3307	Pre-internship Practice		1	0	2	2
			Total	**15**	**2/1**	**6/8**	**20**

6th Semester

Sl No	Code	Course Title		L	T	P	Credits
		Mathematics Major	Physical Sciences Major				
1	ED3302/ ED3304	Content cum Pedagogy of Math at Secondary Stage–III	Content cum Pedagogy of Physical Sciences at Secondary Stage - III	3	1	0	4
2	MA3302/ PH3302	Vector Calculus	Modern Physics	3	1	0	4
3	MA33xx/ CY33xx	Maths Elective – II	Chemistry Elective - I	3 3	1 0	0 2	4
4	ED3306	Assessment & Evaluation		2	0	0	2
5	ED3308	Inclusive Education		2	0	0	2
6	ED3310	Mathematical & Quantitative Reasoning		2	0	0	2
7	ED3312	School Observation (Field Practice)		1	0	2	2
			Total	**16**	**3/2**	**2/4**	**20**

7th Semester

Sl No	Code	Course Title	L	T	P	Credits
1	ED3401	Perspectives on School Leadership & Management	2	0	0	2
2	ED3403	Curriculum Planning & development	2	0	0	2
3	ED3405	Art Education (performing and visual)	1	0	2	2
4	ED3407	Sports, Nutrition & Fitness	1	0	2	2
5	ED3409	School-based research project	0	0	4	2
6	ED3411	Internship on Teaching	0	0	20	10
		Total	**6**	**0**	**28**	**20**

8th Semester

S No	Code	Course Title	L	T	P	Credits
1	ED3402	Philosophical & Sociological Perspectives of Education-II	3	1	0	4
2	ED3404	Education Policy Analysis	2	0	0	2
3	ED34xx	Elective Course	3	1	0	4
4	ED3408	Yoga & Understanding Self	1	0	2	2
5	ED3410	Citizenship Education, Sustainability, and Environment Education	2	0	0	2
6	ED3412	Post Internship (Reviews and Analysis)	1	0	2	2
7	ED3414	Creating Teaching Learning material	1	0	2	2
8	ED3416	Community Engagement and Service	1	0	2	2
		Total	**14**	**2**	**8**	**20**

Professional Electives

Mathematics Elective – I (4th Semester)				
Sl No	**Course Code**	**Course**	**L-T-P**	**Credits**
1	MA3222	Theory of Equations	3 – 1 - 0	4
2	MA3224	Mathematical Logic	3 – 1 - 0	4
3	MA3226	Mechanics	3 – 1 - 0	4

Mathematics Elective – II (6th Semester)				
Sl No	**Course Code**	**Course**	**L-T-P**	**Credits**
1	MA3322	Integral transforms with applications	3 – 1 - 0	4
2	MA3324	Descriptive Statistics	3 – 1 - 0	4
3	MA3326	Mathematical Finance	3 – 1 - 0	4

Chemistry Elective – I (6th Semester)				
Sl No	**Course Code**	**Course**	**L-T-P**	**Credits**
1	CY3322	Instrumental analysis for industrial applications	3 – 1 - 0	4
2	CY3324	Applied organic chemistry	3 – 1 - 0	4
3	CY3326	Environmental Education	3 – 1 - 0	4

Education Elective (8th Semester)				
Sl No	**Course Code**	**Course**	**L-T-P**	**Credits**
1	ED3422	Education for mental health	3 – 1 - 0	4
2	ED3424	Guidance and counseling	3 – 1 - 0	4
3	ED3426	Adolescence education	3 – 1 - 0	4

The Overall Credit Structure

Program / Curricular Component	**Credits**
Induction Program	0
Foundations of Education (FoE) (Common to all across-stage specializations)	30
Disciplinary/interdisciplinary Specific Major/ Minor (MAJ/MIN)	64
Stage Specific – cum- Pedagogy (SCP)	16
Ability Enhancement and Value-added courses (AEV) (Common to all students across stage specializations)	28
School Experience, Including Internship in Teaching (Specific to State Specialization) (SEI)	20
Community Engagement and Service (Common to all students across stage specializations) (CEI)	2
TOTAL	160

SYLLABI

B. Sc. B. Ed. (Secondary Stage with Major in Mathematics / Physical Sciences)

Semester – I

HS3161 **2-0-2 (3)**

Sanskrit

Pre-Requisites: **NONE**

Course Outcomes:

CO-1	Familiarize with Sanskrit language and its classical literature
CO-2	Understand the structure of the verb forms in Sanskrit
CO-3	Understand how Sanskrit as a language has a deep connection with our saṁskṛt
CO-4	Appreciate the richness of our culture by way of teaching it apropos

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3	**PSO-4**
CO-1	–	–	–	–	–	–	–	–	–	–	–	–	**–**
CO-2	–	–	–	–	–	–	–	–	–	–	–	–	**–**
CO-3	–	–	–	–	–	–	–	–	–	–	–	–	**–**
CO-4	–	–	–	–	–	–	–	–	–	–	–	–	**–**

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Introduction to Sanskrit language, Devanagari script and Sanskrit alphabet. Vowels and consonants, pronunciation, classification of consonants, saṁyuktākṣaras (conjunct letters), introduction to śabdas of all the three genders, Ac-sandhis and hal-sandhis

Introduction to the verbs (of both ātmanēpadam and parasmaipadam) in 5 lakārams, tenses, voices, sarvanāma-śabdas, and usage of all the declensions

Introduction to Sanskrit Literature, Kathāmukham of Pañcatantram, and some subhāṣitams

Introduction to Kālidāsa, Meghadūtam - (English translation -Colonel H A Ouvry), verses form VālmīkiRāmāyaṇa and Bhagavatgītā

Learning Resources:

Text Books:

1. Saṃskṛtasvādhyāyaḥ - Published by RashtriyaSamskritaSamsthanam - New Delhi.
2. Abhyāsapustakam - Published by Samskrita Bharati –Bangalore.

Reference Books:

1. Samanvitha Sanskrit 1 - Published by Central Institute of Indian Languages – Mysore.
2. Surasaraswatisabha publications – Sringeri/ Bangalore

ED3101 **2-0-0 (2)**

Understanding India
(Indian Ethos and Knowledge Systems)

Course Outcomes:

CO-1	Recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it.
CO-2	Apply their acquired research and critical thinking skills in multidisciplinary themes.
CO-3	Summarize and pass on their learnings to their students of different Indian traditions in an easily digestible manner.

Syllabus:

Introduction to the Knowledge of India: Definition & scope; Relevance of this knowledge, Need to revisit our ancient knowledge, traditions, and culture.

Culture - Art and Literature: Fine arts (traditional art forms, contemporary arts, arts & spirituality, arts and Identity, and art and globalization); Performing Arts (Indian dance systems, traditional Indian pieces of music, visual arts, folk arts, etc.,); Literature (Sanskrit literature, religious literature, Indian poetry, folk literature, Indian fiction, Sangam literature, Kannada, Malayalam literature, Bengali literature, etc.

Polity and Law: Kingship & types of government (oligarchies, republics); Local administration (village administration). Basis of Law: Dharma & its sources; Criminal Justice: police, jails, and punishments; Lessons from Chanakyaniti; Lessons for modern-day India: Towards a tradition-driven equitable and just polity and law system.

Suggestive Reading Materials:

1. Mahadevan, B., Vinayak Rajat Bhat, Nagendra Pavana, R.N., Introduction to Indian knowledge system: Concepts and applications, PHI Learning Pvt. Ltd.2022
2. Cultural Heritage of India, Vol. 2, 5, 7 (Part I and Part II), The Ramakrishna Mission Institute of Culture, 2002
3. M. Laxikanth, Indian Polity, Mc Graw Hill, 2017

ED3103 **1-0-2 (2)**

Art Education
(Performing and Visual)

Course Outcomes:

CO-1	Articulate the importance of aesthetics and art in elementary education.
CO-2	Demonstrate their familiarity with and appreciation of puppetry.
CO-3	Design puppets.
CO-4	Practice and create a short puppetry show.

Syllabus:

Importance of Aesthetics and Art education: In this unit the basic idea of aesthetics and art, and ways in which the aesthetic dimension manifests itself in human life will be discussed. Using various examples of art, students will engage in identifying aesthetic aspects of daily life, develop aesthetic judgment, and gain familiarity with the role of art in education. Students will also be introduced to three aspects ofart in education: The value of art itself and its use as an instrument in education; moral dimensions of works of art and the controversial distinction between the value of Popular art and High art.

Designing Puppets: In this unit, students will learn about puppetry, its history and specifically about how puppets work. This unit will also discuss the imagination required to design puppets, visualize how puppets will be used and the technicalities of designing puppets. These will be learnt by designing puppets. Students will start with constructing finger puppets and move towards small shapes through papers, like Fish, birds, rat - then they will design masks, flat masks, and masks with dimensions. At the end they will design puppets with old newspaper. The puppets are designed with old newspapers and colour papers. They decorate it and design it in such a waythat it can be played, performed. They prepare costumes and all other accessories.

Suggestive Reading Materials:

1. Ravikant Rao, K., Anand Kumar, P., Krishna Kumar, K.N., Drama And Art in Education, Neelkamal publishers, 2017
2. Rajesh Gill, A textbook of Art Education, Paragon International Publishers, 2019
3. Erwin Panafsky, Meaning in the visual arts, Macat Library, 2018
4. David Currel, An introduction to puppets and puppet making, Book Sales, 1992

ED3105 **3-1-0 (4)**

Evolution of Indian Education

Course Outcomes:

CO-1	Discuss genesis, vision, and evolution of education in ancient India to the contemporary India.
CO-2	Enable themselves to shape their educational perspective to act as an effective teacher.

Syllabus:

Ancient Indian Education: Vedic Period: Vision, objectives and salient features of Vedic Education System, Teaching and Learning Process., Development of educational institutions: Finances and Management, Famous Educational institutions and Guru-Shishya., Education at the time of Epics: Ramayana and Mahabharata.

Ancient Indian Education: Buddhist and Jain Period, Vision, objectives and salient features of Buddhist and Jain Education System, Teaching and Learning Process.**,** Finance and Management of Educational Institutions, Educational Institutions: Nalanda, Taxila, Vikramshila, Vallabhi, Nadia, Famous Guru-Shishya.

Post-Gupta Period to Colonial Period: Vision, objectives, brief historical development perspective as well as salient features ofEducation in India, Teaching and Learning Process, Finance and Management of educational institutions.

Modern Indian Education: Colonial Education in India**,** Woods Despatch, Macaulay Minutes and Westernization of Indian Education**,** Shiksha ka Bhartiyakaran (Indigenous Interventions in Education) (Bird's eye view of their contribution) - Swadeshi and Nationalist attempts of educational reforms with special reference to general contribution of Indian thinkers – Savitribai and Jyotiba Phule, Rabindranath Tagore, Swami Vivekananda,Mahatma Gandhi, Sri Aurobindo, Gijubhai Badheka, Pt. Madanmohan Malaviya, Jiddu Krishnamurti and Dr. Bhima Rao Ambedkar others – to the education systems of India.

Education in Independent India: Overview of Constitutional values and educational provisions. - Citizenship Education - Qualities of a good citizen. Education for fundamental rights and duties. Overview of 20th Century Committees, Commissions and Policies. UEE, RMSA, RTE Act 2009: Overview and impact. NEP 2020: vision and implementation for a vibrant India.

Suggestive Reading Materials:

1. Mookerji, Radha Kumud, Ancient Indian Education: Brahmanical and Buddhist, Motilal Banarsidass publishing House, 2023.
2. Dr. Joseph K Thomas, India's New National Education Policy 2020, The Write Order Publications,2020
3. Altekar, A. S., Education in Ancient India, Manohar Prakashan, 1992.
4. Ghosh, S. C., The History Of Education In Modern India (1757-2012), Orient Blackswan, 4th Edition, 2013.
5. Bharathi chand, Contemporary Education in India, Neelkamal publishers, 2016.

MA3101 **3-1-0 (4)**

Differential and Integral Calculus

Pre-Requisites: None

Course Outcomes:

CO-1	To find the Taylor series expansion of a function.
CO-2	To find the maxima and minima of functions of several variables.
CO-3	To identify the convergence of an improper integral.
CO-4	To evaluate the surface area and volume of a solid of revolution.
CO-5	To compute the surface area and volume of regions using multiple integrations.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Differential Calculus: Taylor's theorem with remainders, Taylor's and Maclaurin's expansions, Curvature and Evolutes, Asymptotes, and Curve tracing.

Functions of several variables - partial differentiation, total differentiation, Euler's theorem and generalization, Change of variables – Jacobians, maxima, and minima of functions of several variables (2 and 3 variables) - Lagrange's method of multipliers.

Integral Calculus: Evaluation of lengths of plane curves, plane areas, volume, and surface area of a solid of revolution

Convergence of Improper integrals, Beta and Gamma integrals, Elementary properties of Beta and Gamma integrals, Differentiation under integral sign.

Double and triple integrals, computation of surface areas and volumes using multiple integrations, change of variables in double and triple integrals.

Learning Resources:

Text Books:

1. Shanti Narayanan, Differential Calculus, S. Chand, and Co., 2021
2. Shanti Narayanan, Integral Calculus, S. Chand, and Co., 2021

Reference Books:

1. George Thomas, J., Ross L. Finney, Calculus, Ninth Edition Pearson, 2018.
2. Sudhir R. Ghorpade, B. V. Limaye, A Course in Calculus and Real Analysis, Springer, 2018.
3. Sudhir R. Ghorpade, B.V.Limaye, A Course in Multivariable Calculus and Analysis, Springer, 2012.

PH3101 **3-0-2 (4)**

Mechanics, Waves and Oscillations

Pre-Requisite: **None**

Course Outcomes:

CO-1	Understand integration of vectors and Stokes greens and gauss theorems
CO-2	Identify and apply the laws of mechanics along with the necessary mathematics for solving numerical.
CO-3	Understand physical characteristics of SHM and obtaining solution of the oscillator using differential equations.
CO-4	Use Lissajous figures to understand simple harmonic vibrations of same frequency and different frequencies
CO-5	Solve wave equation of a longitudinal and transverse vibrations.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Scalar and Vector Fields: Scalar and vector fields, gradient of a scalar field and its physical significance. Divergence and curl of a vector field and related problems, vector integration: line, surface and volume integrals. Stokes, Gauss and Greens theorems, Laws of motion, motion of variable mass system, motion of a rocket, multi-stage rocket, conservation of energy and momentum, definition of rigid body, rotational kinematic relations, and equation of motion for a rotating body, angular momentum and inertial tensor.

Central Forces: Central forces – definition and examples, conservative nature of central forces, conservative force as a negative gradient of potential energy, equation of motion under a central force, gravitational potential and gravitational field, derivation of Kepler's laws. Galilean relativity, absolute frames, Michelson-Morley experiment, Postulates of special theory of relativity. Lorentz transformation, time dilation, length contraction, addition of velocities, mass-energy relation.

Simple Harmonic Oscillator: Simple harmonic oscillator and its solution, physical characteristics of SHM, torsion pendulum, - measurements of rigidity modulus, compound pendulum, measurement of ‗g', Lissajous figures, damped harmonic oscillator and its solution, comparison with undamped harmonic oscillator, logarithmic decrement, relaxation time, quality factor, differential equation of forced oscillator and its solution, amplitude resonance, velocity resonance, coupled oscillators.

Transverse wave propagation: Transverse wave propagation along a stretched string, general solution of wave equation and its significance, modes of vibration of stretched string clamped at ends, overtones, energy transport, transverse, longitudinal vibrations in bars- wave equation and its general solution, Boundary conditions, clamped free bar, free-free bar, bar supported at both ends.

Learning Resources:

Text books:

1. Halliday, Resnick, Walker, Fundamentals of Physics, Wiley India, 2013, Tenth Edition.
2. C. Kittel, W. Knight, M.A. Ruderman, Mechanics, Berkeley Physics Course. Vol.1, McGraw Hill, 2008, Fourth Edition.

Reference books:

1. Hugh D. Young, Roger A. University Physics, Freedman Pearson Education, 2017, Fourteenth Edition.
2. Daniel Kleppner, Robert Kolenkow, An introduction to Mechanics, McGraw Hill, 2017.

Online Resources:

1. https://nptel.ac.in/courses/115/106/115106119/.
2. https://onlinecourses.nptel.ac.in/noc20_ph22/preview.

Lab:

List of Experiments:

1. Determination of gll by simple and compound pendulum.
2. Moment of Inertia of a fly wheel.
3. Determine surface tension of a liquid through capillary rise method.
4. Determination of rigidity moduli by torsion Pendulum.
5. Study of Oscillations under bifilar suspension
6. Observation of Lissajous figures from CRO.
7. Velocity of transverse wave along a stretched string.
8. Study of damping of a bar pendulum.
9. Study of coupled oscillator.
10. Maxwell wheel for the verification of conservation of energy.
11. Determination of the shear modulus of steel, copper, aluminum and brass.
12. Determination of the centrifugal force as a function of the mass.

Learning Resources:

Text Books:

1. Physics Department Manual, NIT Warangal, 2021
2. S.P. Singh, Advanced Practical Physics by Pragati Prakashan, Anu books, Meerut, 2019.

Reference books:

1. R.K Shukla, Anchal Srivastava, Practical Physics, New Age International Private Limited, 2008.
2. C. Kittel, W. Knight, M.A. Ruderman, Berkeley Physics Course, Vol.1, Mechanics, McGraw Hill, 2008, Fifth Edition.

Online Resources:

1. https://www.phywe.com/physics/thermodynamics/
2. https://vlab.amrita.edu/index.php?sub=1&brch=74

MA3103 **3-0-2 (4)**

Python Programming

Pre-Requisites: **None**

Course Outcomes:

CO-1	Introduce the fundamental concepts of Python.
CO-2	provides a foundation for using the basic building blocks of Python.
CO-3	Learn to write Python Scripts.
CO-4	Explore various exception-handling mechanisms.
CO-5	Develop Python packages.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	1	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2		1	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	2	3	2	3	1	2	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Introduction to Python: Python variables, Python basic Operators, Python Data Types, variables, Declaring and using Numeric data types: int, float etc., Basic Input-Output Operations, Basic Operators.

Conditionals and loops: Boolean Values, if, else, and else if, Simple for loops in Python, for loop using ranges, string, lists, and dictionaries. Use while loops in Python, Loop manipulation using pass, continue, break and else.

Strings: Assigning values in strings, String manipulations, String special operators, String formatting operators, Triple Quotes, Raw String, Unicode String, Build-in-String methods.

Lists: Lists Introduction, accessing values in a list, List manipulations, List Operations, Indexing, slicing & matrices, use of tuple data type, programming using string, list, and dictionary in-built functions.

Functions: Built–in Functions and methods, Functions, writing functions in Python, returning a result from a function, Pass by value & pass by reference, function arguments & their types.

Lab : Programs using

1. Conditional control constructs
2. loops
3. Strings
4. Lists
5. user defined functions and library functions
6. built-in functions of packages matplotlib

Learning Resources:

Text Books:

1. William Mitchell, Povel Solin, Martin Novak et al., Introduction to Python Programming, NCLab Public Computing, 2012.
2. Introduction to Python Programming, ©Jacob Fredslund, 2007.

Reference Books:

1. John C. Lusth, An Introduction to Python, The University of Alabama, 2011.
2. Introduction to Python, ©Dave Kuhlman, 2008.

Semester – II

HS3102 **3-1-0 (4)**

English for Communication

Pre-Requisites: English proficiency above B1 level as per the CEFR (Common European Framework of Reference) for languages.

Course Outcomes:

CO-1	Build grammatically correct sentences using a variety of sentence structures and appropriate vocabulary.
CO-2	Demonstrate the use of English speech sounds, stress, and intonation in day-to-day situations/conversations/interactions.
CO-3	Develop active listening skills and strategies for different types of listening such as attentive, selective, and pleasure listening.
CO-4	Compose cohesive and coherent paragraphs, emails, letters, reports, SOPs, reviews, and conference abstracts.
CO-5	Apply various techniques for effective oral presentations and group discussions, demonstrating neutral accent and avoiding vernacular influence.
CO-6	Infer explicit and implicit meaning of a given text, using appropriate listening and reading strategies to meet academic and professional needs.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-6	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Course Overview

The course is designed to train students in receptive (listening and reading) as well as productive and interactive (speaking and writing) skills by incorporating a comprehensive, coherent, and integrated approach that improves the learners' ability to effectively use English language in academic/workplace contexts. The shift is from learning about the language to using the language. On successful completion of the course, learners would be confident of appearing for international language qualification/proficiency tests such as IELTS, TOEFL, or BEC, besides being able to express themselves clearly in speech and competently handle the writing tasks and verbal ability component of campus placement tests. Activity-based teaching-learning methods would be adopted to ensure that learners engage in actual use of language both in the classroom and laboratory sessions.

Syllabus:

Listening (Lab): Types of listening: attentive, selective, pleasure; barriers to listening; effective listening strategies; Short structured talks on specific topics. Task-based listening activities; Listening to motivational speeches and videos (e.g., Steve Jobs, Mark Zuckerberg, renowned scientists like Einstein, C V Raman, Marie Curie, Grigori Perelman, Jennifer A. Doudna, Ted Talks); Listening for specific details and comprehension tests.

Speaking (Lab): Ice-breaking activities, introducing self and others; JAM Session: Hypothetical situations, features of good conversation, situational dialogues, greetings, taking leave, making requests, seeking permissions, role play, discussion in pairs/small groups; Discussing specific topics in pairs or small groups and reporting the discussion, complaining, apologizing; Formal oral presentations on topics from academic contexts, telephone etiquette, non-verbal communication.

Reading: Intensive Reading vs. Extensive Reading, short stories, skimming and scanning, reading for global comprehension, summarizing, paraphrasing; Identifying sequence of ideas, recognizing verbal techniques, reading between the lines, critical reading for evaluation; Reading biographies, magazines, books (fiction and non-fiction).

Writing: Structure of a paragraph and types of paragraphs: descriptive, argumentative, narrative, expository, persuasive; Writing self-profiles, interpreting visual information, predicting, advanced features of good writing (use of cohesive devices and connectives, discourse markers); Official letter writing, email etiquette, cover letter and resume writing, types, drafting e-resumes; SWOT description and analysis, writing SOP, letters for internship/fellowship, writing reviews (books, biographies, short stories), technical reports, conference abstracts, image description, poster presentation

.

Grammar & Vocabulary: Phrasal verbs, verbs, tenses (present, past, future), nouns, prefixes and suffixes, vocabulary building; Idioms and phrasal verbs, synonyms and antonyms, technical vocabulary, concord (subject-verb agreement), correction of sentences; Gender-inclusive language (gendered noun, gender-neutral noun), quantifying expressions, adjectives, adverbs, degrees of comparison, scientific vocabulary; Reported speech, reporting verbs for academic purposes.

Phonetics-Pronunciation (Lab): Introduction to speech sounds: vowels and consonants; Intonation, errors in pronunciation, influence of Mother Tongue (MTI), common Indian variants in pronunciation. Differences in British and American pronunciation, structure of syllables, word stress and rhythm, weak forms and strong forms in context, basic rules of word accent, stress shift.

Learning Resources:

Text Books:

1. Bailey, Stephen. Academic Writing: A Handbook for International Students. Routledge, 2014.

Reference Books:

1. Raymond Murphy, Murphy's English Grammar, Cambridge University Press, 2004.
2. Meenakshi Raman, Sangeeta Sharma, Technical Communication: English Skills for Engineers, Oxford University Press, 2009.
3. Michael Swan, Practical English Usage, Oxford University Press, 1996.
4. Chase, Becky Tarver. Pathways: Listening, Speaking and Critical Thinking. Heinley ELT; 2nd Edition, 2018.
5. Louis Rogers, Skillful Level 2 Reading & Writing Student's Book Pack (B1) Macmillan Educational, 2013.
6. Hewings, Martin. Cambridge Academic English (B2). CUP, 2012.

Other Suggested Readings:

1. https://www.bbc.co.uk/learningenglish/
2. https://www.talkenglish.com/speaking/basics/speaking_basics_ii.aspx
3. https://www.esolcourses.com/content/topicsmenu/listening.html
4. https://www.esl-lab.com/
5. https://www.cambridgeenglish.org/learning-english/free-resources/write-and-improve/.

ED3102 **2-0-0 (2)**

Understanding India
(Indian Ethos and Knowledge Systems)

Course Outcomes:

CO-1	Recognize the vast corpus of knowledge traditions of India, while developing an appreciation for it.
CO-2	Apply their acquired research and critical thinking skills in multidisciplinary themes.
CO-3	Summarize and pass on their learnings to their students of different Indian traditions in an easily digestible manner.

Syllabus:

Economy: Overview of the Indian Economy from the Stone Age to the Guptas: The new culture of Urbanization (including castes, guilds, and other economic institutions; Harappan civilization economy; growth of agriculture and proliferation of new occupations; growth of writing); Internal & external trade and commerce, including trade routes, Indo-roman contacts, and maritime trade of South India; Temple economy. Land ownership - land grants & property rights, land revenue systems.

Understanding Arthashastra: Ideas & Criticism; Locating relevance of ancient Indian economic thought in modern-day Indian Economy.

Environment & Health Understanding Equilibrium between Society & Environment: Society's perceptions of natural resources like forests, land, water, and animals. Sustainable architecture & urban planning; Solving today's environmental challenges (best practices from indigenous knowledge, community-led efforts, etc.). India's Health Tradition: Ayurveda, Siddha, Ashtavaidya, Unani, and other schools of thought; Lessons from Sushruta Samhita and Charaka Samhita; Mental health in ancient India: towards time-tested concepts of mental wellness (concept of mind, dhyana, mind-body relationship, Ayurveda, yoga darshan, atman, etc.)

Suggestive Reading Materials:

1. Tirthankar Roy, The Economic History of India 1857-2010, OUP India, 2020.
2. Sanjaya Baru, Journey of a Nation: 75 years of Indian Economy, Rupa, 2022.
3. K. R. Gupta, Indian Economy – Issues and Concerns, Atlantic, 2018.
4. Dr. Nisha Manikantan, Ayurveda Simplified, Sri Sri publications trust, 2022.

ED3104 **2-0-0 (2)**

Teacher and Society

Course Outcomes:

CO-1	amine the relationship between teacher beliefs, values, character, life history, social and cultural context and teaching critically.
CO-2	plain the teacher roles and characteristics; the personal and professional self; theteacher as a communicator, the charismatic influencer, the reflective practitioner, competent, learner and much more and their significant role in nurturing the posterity.
CO-3	erentiate between the narrow curricular aims of education and the broader educational aims and their role in shaping self, school, and society.
CO-4	monstrate an ability to develop positive classrooms through engaging in the ethic of care.
CO-5	monstrate an ability to critically reflect on personal and collective practice so as to improve learning and teaching.
CO-6	nceptualize teacher agency, its individual, contextual, and structural dimensions and how it gets impacted and in turn shapes education.

Syllabus:

Understanding the Teacher: Exploring the Personal and Professional Teacher: Exploring the wider Personal and General Social Context of Teacher: Life History, Teacher Beliefs, Values and Aspirations, Diverse Identities, Social Contexts and Commitment to Learning and Education. Exploring the Professional Teacher: Qualifications, Education in teaching, Attitude, Aptitude, Experience and Exposure. The Charismatic Teacher, the Communicator Teacher, The Missionary Teacher, The Competent Practitioner, The Reflective Practitioner, The Learning Teacher. Reflexive Practice: Nurturing the Professional Capital through collaborative and/or collective engagement with self, others, the social context.

Nurturing the Teacher: A Dialogue beyond the curricular goals, for Life and Posterity: Teaching: One profession, many roles, Teaching Character: Nurturing Teachers for Human Flourishing. Holistic Teacher Development: Nurturing the Panchakoshas. Teacher Values, Beliefs, and current Philosophy of Teaching: A Reflective Dialogue. Developing an Ethic of Care in Teacher Education: Nurturing Teachers towards a pedagogyof care.

Understanding and Fostering Teacher Agency: Role in shaping Education Systems ofTomorrow: Teacher Agency: What is it and why does it matter? Individual, Cultural and Structural Dimensions of Teacher Agency. Teacher discourses, Philosophy, Relationships, Networks and Professional Development:Shaping teacher agency and Creative insubordination. Challenges and Issues inf fostering Teacher Agency: Performativity, Non-academicengagements, Systemic apathy, Policy and Practice gaps and others. Role of Teacher in shaping the educational policy, practice, and reforms.

Teacher as an Architect of the New India: Shaping the Society of Tomorrow: Engaging in Critical Education: Dialogues on power relations associated with Gender,Ethnicity, Culture, Disability, Class, Poverty, the reproduction of disadvantage and realizing the true human potential. Being a Critical Teacher: Raising debates around rapid technological advancement and impact on individual, family and social life; the growing isolation and impact on mental and social health and well-being, changing relationships between the ‘state’ and the ‘market’ andtheir impact on formal education; the conceptualization of teacher, teaching and teacher roles, ‘globalization’ and the reconstructed nationalism shaping the socio-political milieuand impact on social psyche, growing materialistic urge, sensory drives and the gradual deterioration of the individual and societal character.

Suggestive Reading Materials:

1. Dr. A. Antony, Teacher and Education in Indian Society, Notion press, 2016.
2. J. C. Agarwal, Teacher and Education in a Developing Society, Vikash Publisher, 2010.
3. Frank Musgrove, Philip Taylor, Society and the Teacher's Role (RLE Edu N), Routledge, 2011.
4. BN Dash, Teacher in Emerging Indian Society, Dominant publishers, 2012.

MA3102 **3-1-0 (4)**

Elementary Ordinary Differential Equations

Pre-Requisites: None

Course Outcomes:

CO-1	Test the plausibility of a solution to a differential equation that models a physical situation.
CO-2	Understand situations involving exponential growth or decay and second-order physical systems.
CO-3	Understand the existence and uniqueness of solutions.
CO-4	Solve homogeneous and non-homogeneous linear differential equations with constant coefficients.
CO-5	Solve second-order linear differential equations with variable coefficients.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

Syllabus:

Differential Equations of the first order: Linear Vs. Nonlinear Equations: Homogeneous Differential Equations, Differential Equations Reducible to Homogeneous Form - Exact differential equations, Integrating Factors - Linear equation, Reducible to Linear Form: Bernoulli's equations, Total Differential Equations. Existence and uniqueness of solutions (statement only); equations solvable for p, equations solvable for y, equations solvable for x and Clairaut's type; Applications: Newton's law of cooling, Law of natural growth and decay, orthogonal trajectories.

Differential Equations of Higher Order: Solution of homogeneous linear differential equations with constant coefficients, Solution of Non-homogeneous linear differential equations with constant coefficients, Legendre's equation, Cauchy-Euler equation;

Second-order linear differential equations with variable coefficients by the following methods: (i) complementary function is given, (ii) reducing to normal form, (iii) change of independent variable, (iv) variation of parameters.

Learning Resources:

Text Books:

1. Bronson Richard, Dr. Varsha Gejji, Differential Equations, Schaum Series, 2017, Third Edition.
2. George F. Simmons, Differential Equations with Applications and Historical Notes, McGraw-Hill, 2017, Second Edition.
3. William E. Boyce, Richard C. Diprima, Douglas B. Meade, Elementary differential equations and boundary value problems, Wiley, 2021.

Reference Books:

1. M.D. Rai Singhania, Ordinary and Partial Differential Equations, S. Chand and Co., 2020.
2. Earl A. Coddington, An Introduction to Ordinary Differential Equations, Dover Publications Inc.1989.

MA3104 **3-1-0 (4)**

Analytical Solid Geometry

Pre-Requisites: NIL

Course Outcomes: At the end of the course, the student will be able to

CO1	To understand the fundamental concepts of 3D geometry
CO2	To describe some of the surfaces using 3D geometry
CO3	To explain the properties of planes, lines, spheres and cones.
CO4.	To interpret the problems geometrically and then to get the solution.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	2	1	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	1	1	2	2	–	–	–	–	–	–	–	–
CO-3	2	2	2	2	1	2	1	2	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	1	2	2	1	–	–	–	–	–	–	–	–

Syllabus:

The Plane: Equation of plane in terms of its intercepts on the axis, Equations of the plane through the given points, Length of the perpendicular from a given point to a given plane, Bisectors of angles between two planes, Combined equation of two planes, Orthogonal projection on a plane.

Sphere: Definition-The Sphere through four given points-Equations of a Circle - Intersection of a Sphere and a Line - Equation of a tangent Plane - Angle of Intersection of Two Spheres Radical Plane.

Cones: Definition-Condition that the General Equation of second degree Represents a Cone Cone and a Plane through its Vertex - Intersection of a Line with a Cone - The Right Circular Cone.

Cylinders: Definition of a cylinder. Equation to the cylinder whose generators intersect a given conic and are parallel to a given line, Enveloping cylinder of a sphere. The right circular cylinder. Equation of the right circular cylinder with a given axis and radius.

Learning Resources:

Text Books

1. Analytical Solid Geometry, Shanti Narayan and P K Mittal,S. Chand Limited, 2007 (7th edition).
2. Elementary Treatise on Coordinate Geometry of Three Dimensions, R. J. T. Bell, Macmillan India Ltd, 1994.

Reference Books:

1. A Text Book of Analytical Geometry of Three Dimensions, P.K. Jain and Khaleel Ahmed Wiley Eastern Ltd., 1999.

PH3102 **3-0-2 (4)**

Heat and Thermodynamics

Pre-Requisites: None

Course Outcomes:

CO-1	Gain knowledge in Kinetic theory of gases.
CO-2	Understand the nature of thermodynamic properties of matter like internal energy, enthalpy, entropy, temperature, pressure and specific volume.
CO-3	Understand the significance of first law and second of thermodynamics and their
CO-4	Understand the process of thermal conductivity, viscosity and diffusion in gases.
CO-5	Understand the interrelationship between thermodynamic functions and ability to use such relationships to solve practical problems.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	3	3	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Introduction to thermodynamic system, Zeroth law of thermodynamics, isothermal and adiabatic processes, indicator diagram–reversible and irreversible processes, Carnot‘s engine, Carnot‘s theorem, Second law of thermodynamics, Entropy, entropy measurement, entropy and disorder, entropy of universe, temperature entropy diagram.

Thermodynamic potentials – Maxwell‘s relations– Gibb‘s Helmholtz equation– importance Clausius Clapeyron equation, Stefan Boltzmann‘s law, ratio of specific heats, difference of two specific heats for a perfect gas, Joule Kelvin effect and its expression, Joule Kelvin effect for perfect gas and van der wall‘s gas. First order and second order phase transitions, Different methods of liquification‘s of gases, liquefaction of air by Linde‘s and Claude‘s methods, production of low temperatures, adiabatic demagnetization, refrigeration, working of vapor compression machine and vapor absorption machine.

Black body radiation, Stefan‘s law, distribution of energy in black body spectrum, statement of Wein‘s and Rayleigh-Jean‘s Law. Plank‘s quantum theory of radiation, derivation of Plank‘s Law. Wien‘s and Rayleigh-Jean‘s Law from Plank‘s radiation law.

Maxwell Boltzmann distribution law, Application to an ideal gas, MB distribution law of molecular speeds, mean speed, rms speed and most probable speed of a molecule, relation between them, quantum statistics, Bose Einstein distribution law, energy distribution of photon gas, Fermi Dirac distribution law, Fermi energy of electron gas

Learning Resources:

Text Books:

1. Brij Lal, N. Subrahmanyam, P.S. Hemne, Heat and Thermodynamics, S Chand &co, 2001, Fourth Edition.

2. Mark W. Zemansky, Heat and Thermodynamics, Mc Graw Hill, 2017, Fifth Edition.

Reference Books:

1. Claus Borgnakke, Fundamentals of Thermodynamics, Wiley publisher, 2020.
2. Jean-philippe ansermet, Sylvain d. Brechet, Principles of Thermodynamics, Cambridge University Press, 2019
3. Robert F. Sekerka, Thermal Physics, Elsevier, 2015.

Online resources

1. https://onlinecourses.nptel.ac.in/noc20_ce27/preview
2. https://onlinecourses.nptel.ac.in/noc21_me35/preview

List of Experiments:

1. Study of Thermal conduction of solid bodies (metals and glasses).
2. Determination of Thermal conductivity of metals (Wiedmann-Franz law).
3. Study of phase changes of materials.
4. Determination of adiabatic coefficient of various gases.
5. Determination of specific heat of water.
6. Determine the molar heat capacities of air at constant volume C_v and at constant pressure C_p.
7. Determination of the Joule-Thomson coefficient of N_2 and CO_2.
8. Study of Peltier effect (a) cooling engine, (b) heat pump
9. Black Body Radiation: Determination of Stefan's Constant.
10. Verification of Newton's Law of Cooling.
11. Coefficient of thermal conductivity of a bad conductor using Lee's disc apparatus.
12. Study of Stirling engine working.

Learning Resources:

Text Books:

1. Heat and Thermodynamics Lab Manual, Department of Physics, NITW, 2021
2. S.P. Singh, Advanced Practical Physics, Pragati Prakashan, Anu books, Meerut, 2019.

Reference Books:

1. R.K Shukla, Anchal Srivastava, Practical Physics, New Age International Private Limited, 2008.

Online Resources:

1. https://www.phywe.com/physics/thermodynamics/
2. https://vlab.amrita.edu/index.php?sub=1&brch=194

MA3106 **3-0-2 (4)**

Computer Programming in C

Pre-Requisite: **None**

Course Outcomes:

CO-1	Implement programs using classes and objects.
CO-2	Able to understand the overloading concept.
CO-3	Specify the forms of inheritance and use them in programs.
CO-4	Analyze polymorphic behavior of objects and polymorphism.
CO-5	Understand virtual functions.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	3	2	–	2	–	–	–	–	–	–	–	–	–	–
CO-2	1	–	1	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	1	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	3	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	2	–	2	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

C Fundamentals: The C character set identifiers and keywords, data type & sizes, variable names, declaration, statements.

Operators & Expressions: Arithmetic operators, relational and logical operators, type, conversion, increment and decrement operators, bit wise operators, assignment operators and expressions, precedence and order of evaluation. Input and Output: Standard input and output, formatted output -- printf, formatted input scanf. C pre-processor, command line arguments.

Flow of Control: Statement and blocks, if - else, switch, loops - while, for, do while, break and continue, go to and labels.

Functions: Basic of functions, function types, functions returning values, functions not returning values, auto, external, static and register Variables, scope rules, recursion

Arrays and Pointers: One dimensional, two dimensional arrays, pointers and functions, multidimensional arrays.

Structures Union and File: Structure, union, structures and functions, arrays of structures, file read, file write.

Lab

1. Programs on expression evaluation.
2. Programs on conditional branching, iterations, pattern matching.
3. Programs on function, recursion.
4. Programs on arrays, pointers, parameter passing.
5. Programs on string using array and pointers. 6. Programs on structures, union.

Learning Resources:

Text Books:

1. B. S. Gottfried, "Programming with C", McGraw Hill Education, Fourth edition, 2018.
2. B. W. Kernighan, D. Ritchie, "The C Programming Language", Pearson Education India, Second edition, 2015.

Reference Books:

1. E Balagurusamy, "Computing Fundamentals and C Programming", McGraw Hill Education; Second edition, 2017.
2. Y. Kanetkar, "Let Us C", BPB Publications, Sixteenth edition, 2017.
3. E. Balagurusamy, "Programming in ANSI C", McGraw Hill Education India Private Limited, Seventh edition, 2017.

CY3102 **3-0-2 (4)**

Organic Chemistry – I

Pre-Requisites: None

Course Outcomes:

CO-1	Utilize the concept of physical organic chemistry in organic reactions
CO-2	understand the synthesis and reactivity of various functional groups
CO-3	Understand the biological importance of heterocyclic compounds
CO-4	Analyse the functional group interconversion
CO-5	Know properties of hetero cyclic compounds

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	2	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Chemistry of organic functional groups: Alkanes, olefins, alkynes, halides, alcohols, phenols, ketones, aldehydes, carboxylic acids, ethers, derivatives of carboxylic acids, amines, nitro, azo and cyano compounds; synthesis and basic reactivity with mechanisms.

Functional group interconversion (oxidations and reductions) and Heterocyclic Compounds: Systematic nomenclature of heterocyclic compounds (Hantzsch Widman, replacement and fusion methods), biological importance of heterocyclic compounds. Preparation & Properties of Pyrrole, Furan, Thiophene, Preparation & Properties of Pyridine, quinoline, isouinoline, indole

Learning Resources:

Text Books:

1. R. T. Morrison, R. N. Boyd, S. K. Bhattacharjee, Organic Chemistry, Pearson Education, 2010, Seventh Edition.
2. I. L. Finar, Organic Chemistry, Vol-1, Pearson Education, Sixth Edition.

Reference Books:

1. T. W. Graham Solomonsm C. B. Fryhle, Organic Chemistry, Wiley, Tenth Edition.
2. E. L. Eliel, S. H. Wilen, Stereochemistry of Organic Compounds, Wiley.

Lab Syllabus:

1. Standardization of potassium permanganate
2. Determination of relative surface tension of a liquid with respect to water.

3. Determination of relative viscosity of a given liquid with respect to water at room temperature.
4. To study the effect of impurities (sodium chloride and succinic acid) on the critical solution temperature of organic solvent-water system
5. Determination of the distribution coefficient of acetic acid between water and cyclohexane
6. Blue printing of an object by photochemical reaction
7. Determination of acid strength in citrus fruit.
8. Determination of melting point, mixed melting point
9. Purification of organic compounds by recrystallization, sublimation, distillation
10. Separation of compounds by TLC and Column Chromatography
11. Determining Partition Coefficients of Sulfonamides by Reversed-Phase Chromatography
12. Single-stage preparation of Aspirin and Paracetamol

Learning Resources:

Text Books:

1. Practical Organic Chemistry-G. Mann & B.C Saunders, ELBS Edition and Longman Group Limited, 2002
2. Physical Chemistry Laboratory Manual by Department of Chemistry, NITW.
3. Amritha Anand, Ramesh Kumari, Physical Chemistry Laboratory Manual, Wiley distributors, Dreamtech Press, 2019

Reference Books:

1. Shoemaker D.P., Garland C.W., Nibler J.W., Experiments in Physical Chemistry, McGraw Hill, 2008, Eighth Edition.
2. J.B. Yadav, Advanced Practical Physical Chemistry, Krishna's Educational Publishers, 2019, Thirty Eighth Edition.
3. Text Book of Practical Organic Chemistry, Vogel A.I., ELBS, 2004, Fifth Edition.

Semester – III

ED3201 **3-1-0 (4)**

Child Development and Educational Psychology

Course Outcomes:

CO-1	Describe the meaning, concept, characteristics, and factors affecting growth and development.
CO-2	Use the knowledge of Indian concept of self.
CO-3	Apply various problem solving and learning strategies in real classroom settings.
CO-4	Identify the various approaches of the process of learning.

Syllabus:

Child Development: Meaning and significance of understanding the process of Child Development (Biological, cognitive, socio-emotional, and moral), Developmental characteristics of a child during: (Infancy stage, Early Childhood stage, Middle to Late Childhood stage, Adolescence stage), The Indian concept of self: (Mind Intellect, Memory, Panch-koshIya Vikas), Educational Implications.

Developmental Process: Development across domains (Physical Development, Cognitive Development, Language Development, Socio-Emotional Development, Aesthetic Development, Moral Development) During each of the above-mentioned developmental stages of a child, Factors affecting development. Individual differences (Children with special needs including developmental disorders, Tools and Techniques for Identifying Learner with different abilities, Teachers' role and strategies to address the needs of learners with different learningabilities)

Process of Learning: Conceptual Clarity and significance, Approaches (Behaviorist, Cognitivist, Constructivist, Developmental, Information processing Model of learning, Shri Aurobindo's Integral approach), Problem Solving and Learning Strategies: Inquiry and problem-based learning, Steps and Strategies in problem solving, Factors hindering problem solving. How to Learn: Significance and Strategies

Motivation and Classroom Management: Motivation (Conceptual clarity, nature, and significance, Intrinsic and Extrinsic Motivation, Strategies for Motivation), Classroom management (Creating a positive learning environment, Planning space for learning, Managing behavioral problems), Group dynamics (Classroom as a social group, Characteristics of group, Understanding group interaction-sociometry, Strategies to facilitate group learning)

Suggestive Reading Materials:

1. S. K. Mangal, Child development and Educational Psychology, PHI, 2018.
2. E. B. Hurlock, Development psychology – A Life span approach, Tata McGraw Hill, 2020, 5th Edition.
3. Feldman RS, Development across the life span, Pearson, 8th Edition.

ED3203 **3-1-0 (4)**

Basics of Pedagogy at the Secondary Stage

Course Outcomes:

CO-1	Build comprehensive understanding of secondary stage learners.
CO-2	Assess the physical, mental, social, and emotional growth of secondary stage learners.
CO-3	Develop skills to observe and recognize the unique capabilities and strengths of secondarystage learner.
CO-4	Discuss the necessary knowledge and skills to implement effective teaching and learningstrategies.
CO-5	Create enriching and inclusive learning environments to foster values-based education.
CO-6	Develop a deeper understanding of various pedagogical approaches and their impact onlearners.
CO-7	Determine the knowledge to make informed decisions about instructional practices.
CO-8	Explain the crucial role of pedagogy in facilitating effective learning experiences forstudents.
CO-9	Outline knowledge and skills necessary for continuous professional development.

Syllabus:

Understanding Secondary Stage Learners: Understanding the learners and learner background (i). The physical, mental, social, and emotional growth of learners, ii) Thought processes and cognitive skills of learners. iii)Psychological and social orientations of learners, iv) Social and academic lives of learners, v) Conflicts and challenges of secondary learners, vi) Characteristics of secondary stage learners) Observing the unique capabilities of a child

Strategies of Teaching and Learning: Understanding teaching and learning strategies: (i) Concept, characteristics and functions of teaching, ii) Making abstract concepts enjoyable by relating them to real-life situations, iii) Promoting multidisciplinary learning through integration of different disciplines, iv)Promoting learner participation and engagement in learning, v) Building values through art integrated activities, community engagement etc. vi) Promoting multidisciplinary learning through integration of different disciplines vi) Promoting health and social sensitivities, vii) Developing respect toward cultural heritage viii) Making classrooms inclusive and joyful learning spaces) Relationship between Aims and Values of Education, Curriculum and Pedagogy

Pedagogical Approaches: Pedagogical approaches: constructivist approach; collaborative approach; reflective approach; integrative approach, inquiry- based approach; other contemporary approaches,art-integrated learning, sports- integrated learning. Types of pedagogy: social pedagogy; critical pedagogy; culturally responsive pedagogy; Socratic pedagogy in inclusive setup. Role of pedagogy in effective learning: how does pedagogy impact the learner?

Continuous Professional Development of Teacher, Meaning and need, professional and ethical competencies and need for updating content and pedagogical competencies to develop their professional competencies. Professional development activities: seminars, conferences, orientation programmes, workshops, online and offline courses, competitions, publications, development of teaching portfolio, capacity building programmes, and teacher exchange programmes. Development of professional competencies to deal with gender issues, equity and inclusion, ethical issues, environmental issues, human health and well-being, population, human rights, and various issues (emotional, mental, physical issues related to pandemic (for example covid-19).

Suggestive Reading Materials:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India (English and Hindi)

- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.
- National Policy on Education 1968, 1986 and 2020.

Teachers may suggest books/readings as per the need of the learners and learning content.

MA3201 **3-0-2 (4)**

Modern Algebra

Pre-Requisites: None

Course Outcomes:

CO-1	Discover the binary operations as basic entities which give specific mathematical structures
CO-2	Understand the group structure and possible subgroups
CO-3	Analyze the structure of rings and subrings
CO-4	Classify the groups and rings using isomorphisms between the respective mathematical structures
CO-5	Adapt with mathematical abstractness

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-2	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-3	2	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-4	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-
CO-5	3	2	2	-	-	-	-	-	-	-	-	-	-	-	-	-

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Groups: Binary operation, Definition and examples of Groups, preliminary lemmas; dihedral groups, symmetric groups, the quaternion group as special examples; Subgroups - Abelian and non-Abelian groups, Cyclic groups; permutation groups; Cosets, Lagrange's Theorem and its consequences on finite groups; a counting principle; Normal Subgroups and Quotient Groups; Centralizers, Normalizers, Centre of a group;

Mappings between Groups: Homomorphism between groups, the kernel of a group, fibers of Homomorphisms, isomorphism, Fundamental theorem of isomorphism on groups; Automorphisms; Cayley's Theorem; Permutation groups;

Rings: Definition of rings and various examples; units & zero divisors of a ring; special classes of rings (viz., division ring, integral domain, field), characteristic of an integral domain; homomorphisms on rings; Ideals and Quotient rings;

Learning Resources:

Text Books:

1. I. N. Herstein, Topics in Algebra, John Wiley & Sons, 1975, Second Edition.
2. David S. Dummit, Richard M. Foote, Abstract Algebra, Wiley, 2004, Third Edition.

Reference Books:

1. Vijay K. Khanna, S. K. Bhambri, A Course in Abstract Algebra, Vikas Publishing House, 2013, Fourth Edition.
2. Joseph A. Gallian, Contemporary Abstract Algebra, Cengage Learning, 2013, Eighth Edition.
3. John B. Fraleigh, A First Course in Abstract Algebra, Pearson, 2013, Seventh Edition.

MA3203 **3-1-0 (4)**

Numerical Analysis

Pre-Requisites:

Course Outcomes:

At the end of the course, the student will be able to

CO1	find the roots of nonlinear equations numerically
CO2	interpolate the given data by different interpolating polynomials
CO3	find the value of the derivative at a tabulated point
CO4	evaluate the definite integrals using Newton quadrature formula

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-2	2	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-3	1	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-4	2	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–

1 – Slightly; 2 – Moderately; 3 – Substantially

Syllabus:

Solutions of Algebraic and Transcendental equations: The Bisection Method- Method of False position, Newton Method and Its Extensions- Error Analysis for Iterative Methods- Accelerating Convergence

Solution of linear algebraic system of equations: Gauss-Seidel iteration methods, Solution of tridiagonal system, Ill conditioned equations.

Interpolation: Unequally spaced data – Lagrange's and Newton's divided difference formulae, Equally spaced data –finite differences, finite difference (Forward, Backward, and central) operators and their properties, Newton forward and Backward difference interpolation formula, Central difference interpolation formula

Numerical differentiation: Differentiation: Finite difference approximations for first and second order derivatives.

Numerical Integration- Newton Cotes formula, Composite Trapezoidal, Simpson 1/3, and 3/8 rules.

Numerical solution of ordinary differential equations: Taylor's, Euler method, Modfied Euler method, Runge-Kutta 4th order method

Learning Resources:

Text Books:

1. Numerical Analysis: Mathematics of Scientific Computing, D. Kincaid and W. Cheney, 3rd Edition., American Mathematical Society, 2009.
2. Numerical Methods for Engineers and Scientists, M.K. Jain, SRK Iyengar and R.K Jain, New Age International, 2008.

3. Computer Oriented Numerical Methods, V. Rajaraman, Third Edition, Prentice Hall of India, 2006.

Reference Books:

1. Introduction to Numerical Analysis, F.B.Hildebrand, Dover Publications Inc, 2003
2. Introductory Methods of Numerical Analysis, S.S.Sastry, Prentice Hall of India, 2012
3. Elementary Numerical Analysis: An Algorithmic Approach, S.D. Conte and C. de Boor, Mc-GrawHill, 1981.

PH3201 **3-0-2 (4)**

Optics

Pre-Requisites: None

Course Outcomes:

CO-1	Understand the concepts of geometrical optics, its construction and importance in optical instruments.
CO-2	Understand and minimize the aberrations in lenses and its applications
CO-3	Explain the physics of image formation based on the fundamental principles of optics
CO-4	Analyze the intensity variation of light due to polarization, interference and diffraction.
CO-5	Analyze the optical applications using the concepts of interference, diffraction and polarization.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Geometric Optics: Optical path, Fermat's principle of Extreme path, applications, Law of reflection, refraction, cardinal points of an optical system, Image formation, Magnification, Cardinal points of a thick lens, focal length of a thick lens, Bi-convex lens, power of a thick lens, Telescopes types, advantages. Translation matrix, refraction matrix, system matrix for thick and thin lens, system matrix for two thin lenses. Dispersion by a prism, dispersive power, angular and chromatic dispersions.

Aberrations in lenses: Aberrations in lenses, Chromatic Aberration, Achromatic Combination of lenses, Monochromatic defects, Spherical aberration, Astigmatism, Coma, Curvature and Distortion, Minimizing aberration.

Interference: Huygens's wave theory of light-Laws of reflection and refraction.- Division of amplitude and wave front; Phase change on reflection: Stokes' treatment; Interference in Thin Films: parallel and wedge-shaped films; Fringes of equal inclination (Hai dinger Fringes); Fringes of equal thickness (Fizeau Fringes); Michelson Interferometer Application; Fabry- Perot interferometer.

Diffraction: Fresnel and Fraunhofer classes of diffraction, Fraunhofer diffraction at single, double ,multiple slits and circular aperture. Diffraction grating- Determination of wavelength of light using diffraction grating (Normal incidence and Minimum deviation); Resolving power; Rayleigh's criterion –limits of resolution for telescopes and microscope, Zone plate- construction and its comparison with convex lens.

Polarization: Polarization of light; Malus law; polarization by reflection; Brewster's law; Analysis of linearly and circularly polarized light; Polarization by double refraction and Huygen's theory; Nicol prism, Half wave and Quarter wave plates; Optical activity and Fresnel's theory, laurents half shade polarimeter; Biquartz polarimeter.- Photo Elasticity- Polariscope.

Learning Resources:

Text Books:

1. Ajoy Ghatak, Optics, McGraw Hill, 2015, Third Edition.
2. Francis Arthur Jenkins, Harvey Elliott White, Fundamentals of Optics, McGraw-Hill, 2018, Fifth Edition.

Reference Books:

1. Optics-Hecht, Zajak; Addison-Wesley, 2015, Third Edition.
2. V. Rajendran, Engineering Physics, Tata McGraw-Hill Education, 2009.

Online Resources:

1. https://nptel.ac.in/courses/122/107/122107035/
2. https://isaacphysics.org/concepts/cp_diffraction
3. https://www.rp-photonics.com/

List of Experiments:

1. To determine the refractive index of a prism by using a spectrometer.
2. To find the wavelength of white light by a plane transmission diffraction grating.
3. To find the specific rotation of sugar solution by using a polarimeter.
4. To find the wavelength of Sodium light by Newton‘s ring.
5. To verify the expression for the resolving power of a Telescope.
6. To find refractive index of the given liquid samples and find Molar refraction and specific refraction
7. Polarization of Light & Verification of Malus Law
8. Determination the wavelength of He-Ne laser using diffraction grating.
9. Spectrometer- Determination of Cauchy's constants
10. Dispersive power of a prism
11. Determination of numerical aperture and acceptance angle of the optical fiber using laser
12. Determination of thickness of thin wire–Air Wedge
13. Brewster‘s Angle determination

Learning Resources:

Text Books:

1. Optics Lab Manual by Department of Physics, NITW, 2021.
2. S. K. Gupta, Engineering Physics Practical, Ninth Edition, Krishna Prakashan Media publishers, 2010

Reference Books:

1. Indu Prakash, Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi, 2011, Eleventh Edition.
2. Jr. W.D. Callister, Materials Science and Engineering: An Introduction, Wiley, New York, 2007, Seventh Edition.

Online Resources:

1. http://www-math.mit.edu/~gs/
2. https://nptel.ac.in/courses/111/106/111106051/

MA3205 **3-0-2 (4)**

Data Structures with C

Pre-Requisites: None

Course Outcomes:

CO-1	Understand the concept of data structure and create new data structure and also analyzing the efficiency of the same.
CO-2	Identify and differentiate different types of data structures and implement the appropriate data structure and analyze the same.
CO-3	Understand and implement stack, queue and dequeue by selecting appropriate methods.
CO-4	Understand and implement different non-linear data structures by selecting appropriate methods.
CO-5	Understand different factors of sorting and searching algorithm and select the appropriate algorithm and also implement and analyze the algorithm.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	3	3	1	2	–	–	–	–	–	–	–	–	–	–
CO-2	3	3	3	3	-	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	3	3	3	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	3	1	2	–	2	–	–	–	–	–	–	–	–
CO-5	3	3	3	3	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Array: Introduction to sequential representation, Linearization of multidimensional array. Application of array- representation of polynomial using array, Representation of Sparse matrix using array.

Sorting and searching: Definition and need of sorting, different types of sorting algorithm(Bubble sort, Insertion sort, Selection sort, Quick sort, Merge sort, Radix sort, Sequential search, Binary search

Linked List: Introduction to linked representation, Implementation of different types of linked listSingly linked list, Doubly linked list, Circular linked list, Circular Doubly Linked List. Application of Linked list- Representation of polynomial.

Stack: Definition of Stack, implementations of stack using array and linked list Applications of stack- infix to postfix conversion, Postfix Evaluation Recursion: Principles of recursion - use of stack, tail recursion. Tower of Hanoi using recursion.

Queue: Definition of Queue; Implementation of queue using array- physical, linear and circular model; Implementation of queue using linked list.

Dequeue- Definition and different types of dequeue

Learning Resources:

Text Books:

1. Fundamentals of Data Structures of C by Ellis Horowitz, Sartaj Sahni, Susan Anderson-freed 2nd Edition, Universities Press

2. Data Structures and Program Design In C by Robert L. Kruse, Bruce P. Leung 2nd Edition, Pearson

Reference Books:

1. Samiran Chattopadhyay, Debabrata Ghosh Dastidar, Matangini Chattopadhyay, Data Structures Through 'C' Language by, Edition: 2001, BPB Publications
2. Data Structures by S. Lipschutz, Special Indian Edition, Tata McGraw Hill Education (India) Private Limited
3. Data Structures in C by Aaron M. Tenenbaum, 1st Edition, Pearson.

Lab

- Implementation of Bubble sort, selection sort, Insertion sort, Quick sort, Merge Sort and Radix sort using appropriate data structure.
- Implementation of list as data structure using linked list of different types.
- Implementation of polynomial as data structure using array and linked list.
- Implementation of sparse matrix as data stricture using array.
  Implementation of stack as data structure using array and linked list.
- Implementation of queue as data structure using array (physical, linear and circular model) and linked list.
- Converting infix to post-fix and evaluating post-fix expression using stack.
- Implementing Tower-of-Hanoi problem

CY3201 **3-0-2 (4)**

Inorganic Chemistry-1

Pre-Requisites: None

Course Outcomes:

CO-1	Compare the periodic properties of elements in s & p block elements
CO-2	Understand the various theories of acids and bases
CO-3	Learn the concepts of electrode potentials, emf and factors influencing emf
CO-4	Apply various acid-base theories to understand strengths of acid bases
CO-5	Apply the knowledge of redox potentials in understanding the corrosion process

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	2	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Periodicity of Elements: s & p-block elements: Effective nuclear charge, screening effect, Slater rules, Atomic and ionic radii, Ionization enthalpy, Electron gain enthalpy, Electronegativity, Diagonal relationship, Inert pair effect.

Acids and bases: Arrhenius theory, Bronsted theory, Lewis theory, Lux theory, Strength of acid and bases, Hard and soft acids and bases, Superacids

Redox chemistry: Redox reaction and EMF, Electrodes and Electrochemical cells, Effect of pH, precipitation, complex formation on emf, Redox potential diagrams, Redox titrations, Practical applications, Corrosion,

Learning Resources:

Text Books:

1. J. D. Lee, Concise Inorganic Chemistry, Wiley India, 2015, Fifth Edition.
2. Catherine E. Housecroft, A. G. Sharpe, Inorganic chemistry, Pearson, 2018, Fifth edition.

Reference Books:

1. Huheey, J. H., Keiter, E. A., Keiter, R. L., Medhi, O. K., Inorganic Chemistry: Principle of structure and reactivity, Pearson Education India, 2006, Fourth Edition.
2. D. F. Shriver, P. W. Atkins, Inorganic Chemistry, Oxford University Press, 2006, Fourth Edition.

Lab Syllabus:

1. Determination of Mn^{2+} in pyrolusite by permanganometric method.
2. Determination of Fe^{2+} in hematite by dichrometric method.

3. Determination of total hardness of water by complexometric method.
4. Determination of Al^{3+} by back titration method.
5. Determination of Zn^{2+} by precipitation titration method.
6. Determination of sulphate by spectrometric method.
7. Determination of fluoride by ion-selective method.
8. Determination of Cu^{2+} by conductometric titration method.
9. Determination of Ni^{2+} by colorimetry
10. Analysis of kidney stones by permanganometric titration.
11. Determination of calcium in milk powder by EDTA complexometry.

Learning Resources:

Text Books:

1. G H Jeffery, J Bassett, J Mendham and R C Denney, Vogel's Textbook of Quantitative Chemical Analysis, Longman Inc., 1989, Fifth Edition.
2. J. D. Woolins, Inorganic Experiments, John Wiley & Sons, 2010, Third Edition.

Reference Books:

1. Elias, A. J., A Collection of Interesting General Chemistry Experiments, Universities Press (India) Pvt. Ltd., 2002
2. Practical Inorganic Chemistry: Preparations, Reactions and Instrumental Methods, Springer, 1979, Second Edition.
3. Z. Szafran, R. M. Pike, M. M. Singh, Microscale Inorganic Chemistry: A Comprehensive Laboratory Experience, Wiley, 1991, First Edition.

Semester – IV

ED3202 **3-1-0 (4)**

Philosophical & Sociological Perspectives of Education-I

Course Outcomes:

CO-1	To encourage students to explore the nature of knowledge, the nature of human beings, the nature of society and its aims and the educational implications of these understandings.
CO-2	To engage the prospective teachers to read and acquaint themselves with the meaning of terms like Vidya, Avidya, Shiksha, Education etc. and to facilitate them to understand anddifferentiate them through reflections on these terms on the basis of ancient Indian texts.
CO-3	To facilitate prospective teachers to engage themselves in peer groups for sharing of theirreal-life reflective experiences regarding socio-cultural and philosophical living and facilitate them to conceptualize the meaning of terms like philosophical, social andcultural traditions in Indian educational context.
CO-4	To facilitate prospective teachers to engage themselves in peer groups for sharing of theirreal-life reflective experiences regarding socio-cultural and philosophical living and facilitate them to conceptualize the meaning of terms like philosophical, social andcultural traditions in Indian educational context.

Syllabus:

Education and Philosophy: Conceptual clarity, nature and relationships, Aims of studying philosophical perspective of education, Branches of Philosophy and their educational implications: Metaphysics, Epistemology, Axiology - Understanding Indian Perspective of Education- Meaning, nature and aims of education with special reference to Vedic, Buddhist, Jain, Sikh and Islamic traditions- Understanding the terms Darshana, Para and Apara Vidya, Avidya, Shiksha, Samvaad, Panchkosha, Gurukulam, Acharya, Guru, Shishya, Upadhyaya, Jigyasa, Swadhyaya, Understanding Western Perspective of Education - Meaning, Nature and aims of education with reference to Cognitive, Behaviorist and Developmental theories of Education.

Philosophical Schools and Education: Conceptual Clarity of the following schools of thoughts with their implications foreducational practices,
Bharatiya: Samakhya, Yoga, Nyaya, Vaisheshika, Mimansa, Vedanta,
Western: Idealism, Naturalism, Pragmatism, Progressivism.

Educational Thinkers : Deliberations on aims, process and educational institutions developed on thoughts of following thinkers and practitioners:
Bharatiya: Swami Vivekananda, Sri Aurobindo Ghosh, Gurudev Rabindra Nath Tagore, J. Krishnamurti, Mahamana Madan Mohan Malaviya, Mahatma Gandhi, Gijubhai Badheka.
Western: J. Rousse, Maria Montessori, Friedrich Froebel, John Dewey.

Value Education: Conceptual Clarity, Significance and Types of Values, Indian Traditional Values, Guru-Shishya-Parampara and Educational Values, Convocation message in Taittiriya Upanishad, Values enshrined in Indian Constitution, NEP, 2020 and Values with special reference to 21st Century, Pedagogical Issues.

Suggestive Reading Materials:

1. Prof. Gara Latchanna, Dr. G. Viswanathappa, K. Srinivas, Foundations of education, Neelkamal Publications, 2016, First Edition.
2. J. C. Agarwal Philosophical Foundations of Education, Shri Vinod Pushtak Mandir, 2009.

ED3204 **3-0-2(4)**

Content cum Pedagogy of Math at Secondary Stage–I

Course Outcomes:

CO-1	Appraise the contribution of Indian Knowledge Systems in development of Mathematics.
CO-2	Explain the nature of Mathematics as an important subject for human development.
CO-3	Interpret the recommendation of the various policy documents in reference toMathematics education.
CO-4	Classify the aims and objectives of teaching Mathematics.
CO-5	Formulate objectives based on learning outcomes for Mathematics teaching.
CO-6	Select and demonstrate various approaches and methods of teaching Mathematics.
CO-7	Plan strategies to inculcate values through teaching Mathematics.

Syllabus:

Nature, Scope and Historical Perspective of Mathematics: Development of Mathematics from a historical perspective, Nature of Mathematical Knowledge – Axioms and Postulates, Conjectures, Proofs in Mathematics: inductive - deductive reasoning, theorems, mathematical modeling. Importance of Mathematics knowledge in everyday life. Recommendations of various committees, commissions and policies related to Mathematics education at Secondary stage (especially in National Education Policies andNational Curriculum Frameworks).

Aims and Objectives of Teaching Mathematics: Aims and objectives of teaching Mathematics at secondary stage. Learning outcomes and competencies of teaching Mathematics at secondary stage. Linkages of Mathematics with other school subjects and place in school curriculum. Inculcation of values through teaching of Mathematics.

Pedagogical Aspects of Mathematics: Implication of various approaches of teaching Mathematics – inductive deductive, analytical synthetical, constructivist, blended learning, experiential learning, transdisciplinary, interdisciplinary, and multidisciplinary. Learner-centric and participative methods of teaching of Mathematics: lecture cumdemonstration, problem-solving, laboratory, project based. Analytical pedagogical concerns in teaching of Mathematics for higher order thinking skills such as critical, creative, decision making, reflective, collaborative, and cooperative. Techniques of teaching learning Mathematics: oral, written, drill work, homework, self- study, group study, supervised study, concept-mapping, learning, art and sports integratedlearning.

Suggestive Reading Materials:

- MESE 001(2003) Teaching and Learning Mathematics. IGNOU series
- NCERT Publications: Pedagogy of Mathematics (Code-13074)

Teachers may suggest books/readings as per the need of the learners and learning content.

ED3206 **3-0-2(4)**

Content cum Pedagogy of Physical Sciences at Secondary Stage–I

Course Outcomes:

CO-1	Explain nature, scope and importance of Physical Sciences.
CO-2	Illustrate aims and objectives of teaching Physical Sciences for sustainable developmentof society.
CO-3	Outline linkages between Physical Sciences and other subjects.
CO-4	Identify the values and importance of Physical Sciences and alternative knowledge systems.
CO-5	Summarize the historical/policies perspective of Physical Sciences.
CO-6	Examine pedagogical concerns of Physical Sciences.
CO-7	Categorize approaches and methods of teaching learning Physical Sciences.
CO-8	Apply appropriate pedagogy in teaching learning the concepts of Physical Sciences.

Syllabus:

Nature, Scope and Historical Perspective of Physical Sciences: Nature, scope, and importance of Physical Sciences., Historical perspective of Physical Sciences., Contributions of Indian (ancient and modern) and other scientists., Physical Sciences, society and human and sustainable development., Recommendations/suggestions of various committees, commissions, and policies inreference to Physical Sciences.

Aims and Objectives of Physical Sciences: Aims and objectives of teaching Physical Sciences., Learning outcomes and competencies of teaching Physical Sciences at secondary stage. Linkages of Physical Sciences with other school subjects and place of the PhysicalSciences in school curriculum. Values of Physical Sciences: scientific attitude and appreciating other systems ofknowledge / alternative knowledge systems.

Pedagogical Aspects of Physical Sciences: Implication of various approaches - inductive deductive, constructivist, experiential learning, art integrated learning, sports integrated learning, blended learning, interdisciplinary and multidisciplinary approaches in Physical Sciences. Analytical pedagogical concerns in teaching of Physical Sciences for higher order thinking skills such as critical, creative, communication, decision making, reflective. Methods of teaching learning Physical Sciences: learner-centric and group-centric, lecture cum demonstration, activity based, discussion, problem-solving, laboratory, stem and steam, project based, scientific inquiry, hands on activity, discovery, experimentation,concept-mapping, collaborative and cooperative learning.

Suggestive Reading Materials:

- National Council of Educational Research and Training. (April 2022). Mandatedocuments Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023). DraftNational Curriculum Framework for School Education.
- NCERT, Textbooks of Physical Sciences at Secondary Stage.

Teachers may also suggest books/readings as per the need of the learners and learning content.

MA3202 **3-1-0 (4)**

Linear Algebra

Pre-Requisites: None

Course Outcomes:

CO-1	Demonstrate the knowledge of vector space and subspaces.
CO-2	Find rank and nullity of a linear transformation and the corresponding matrix.
CO-3	Test the consistency of system of linear algebraic equations.
CO-4	Solve eigenvalue problems.
CO-5	Illustrate the concept of inner products and orthogonalization.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

Syllabus:

System of Linear Equations: Elementary row operations, Row echelon form, Row reduced echelon form, Determinant, Rank of a matrix, Inverse of a matrix by elementary operations. Solutions of Homogeneous and Non-homogeneous linear system of equations.

Diagonalization of Matrices: Characteristic equation, Eigenvalues and eigenvectors of a matrix, Cayley-Hamilton Theorem and its use in finding inverse of a matrix and in finding higher powers of a matrix, Similar matrices, Diagonalization of square matrices.

Vector Spaces and Linear Transformations: Vector spaces, Subspaces, Linear dependence and independence, Span of a set, Basis and dimension, Direct sum, Quotient space. Linear transformations, Range and null space, Rank and nullity, Change of basis.

Orthogonality: Inner Product, Length, and Orthogonality-Orthogonal Sets.

Learning Resources:

Text Books:

1. Stephen H. Friedberg, Arnold J. Insel, Lawrence E. Spence, Linear Algebra, Pearson Education, 2022, Fifth Edition.
2. Gilbert Strang, Introduction to Linear Algebra, Wellesley-Cambridge Press, 2009, Fourth Edition.

Reference Books:

1. K. Hoffman, R. Kunze, Linear Algebra, Pearson Education, 2005, Second Edition.
2. S. Lang, Linear Algebra, Undergraduate Texts in Mathematics, Springer-Verlag, 2004.
3. M. Thamban Nair, Arindama Singh, Linear Algebra, Springer, 2018.

Online Resources:

1. http://www-math.mit.edu/~gs/
2. https://nptel.ac.in/courses/111/106/111106051/

MA3204 **3-1-0 (4)**

Digital Computer Fundamentals

Pre-Requisites: **None**

Course Outcomes:

CO1	Identify the logic gates and their functionality.
CO2	Perform number conversions from one system to another system
CO3	Understand the functions of combinational circuits
CO4	Perform number conversions.
CO5	Perform Counter design and learn its operations.

Syllabus:

Number System sand Codes: Number System–Base Conversion – Binary Codes – Code Conversion. Digital Logic: Logic Gates – Truth Tables – Universal Gates.

Boolean Algebra: Laws and Theorems – SOP, POS Methods – Simplification of Boolean Functions– Using Theorems, K-Map, Prime – Implicant Method–Binary Arithmetic: Binary Addition
– Subtraction – Various Representations of Binary Numbers– Arithmetic Building Blocks – Adder – Subtractor

Combinational Logic: Multiplexers – Demultiplexers – Decoders – Encoders –Code Converters–Parity Generator sand Checkers.

Sequential Logic: RS, JK, D, and T Flip-Flops – Master-Slave Flip-Flops.
Registers: Shift Registers–Types of Shift Registers

Counters: Asynchronous and Synchronous Counters - Ripple, Mod, Up- Down Counters– Ring Counters. Memory: Basic Terms and Ideas –Types of ROMs –Types of RAMs.

Learning Resources:

Text Books:

1. V. Rajaraman and T.Radhakrishnan, Digital Computer Design, Prentice HallofIndia,2001
2. D .P. Leach and A. P. Malvino, Digital Principle sand Applications–TMH–Fifth Edition– 2002.
3. M. Moris Mano, Digital Logic and Computer Design,PHI,2001.

Reference Books

1. T.C. Bartee, Digital Computer Fundamentals, 6th Edition, Tata McGraw Hill,1991.

Web Resources

1. https://onlinecourses.swayam2.ac.in/cec19_cs06/preview
2. **https://onlinecourses.swayam2.ac.in/cec21_cs17/preview**

PH3202 **3-0-2 (4)**

Electricity and Magnetism

Pre-Requisites: None

Course Outcomes:

CO-1	Demonstrate the application of Coulomb‘s law for the electric field.
CO-2	Understand the relation between electric field and potential.
CO-3	Calculate the magnetic forces that act on moving charges and the magnetic fields
CO-4	Apply Gauss‘s law of electrostatics to solve a variety of problems.
CO-5	Understand the concepts of induction and self-induction.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	3	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	2	1	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	3	2	1	–	–	–	–	–	–	–	–	–	–	–	–

Syllabus:

Electrostatics : Electric Field and Electric Potential- Electric flux. Gauss' Law with applications to charge distributions with spherical, cylindrical and planar symmetry; Electrostatics- Coulomb‘s law and applications, Laplace's and Poisson equations, The Uniqueness Theorem, Potential and Electric Field due to an arbitrary charged wire, sphere, disc, electric dipole, Force and Torque on a dipole, Energy stored in an electric field; Electrostatic energy of system of charges- Electrostatic energy of a charged sphere, Conductors in an electrostatic Field, Surface charge and force on a conductor, Capacitance of a system of charged conductors, Parallel-plate capacitor.

Magnetism : *Magnetic Field*- Lorentz force, Biot-Savart's Law, Magnetic force between current elements, Ampere's Circuital Law, Maxwell's corrections in Ampere's law; Curl and Divergence of B, vector potential, magnetic flux, Calculation of B for circular and solenoid currents, Magnetic Force on (i) point charge (ii) current carrying wire (iii) between current elements. Torque on a current loop in a uniform Magnetic Field; Intensity of magnetization, Relation between B, H and M.

AC & DC currents: *Steady currents*-Electric current and drift velocity, current density, equation of continuity, electric resistivity and conductivity, Wiedemann-Frenz Law; *Alternating Current*- Mean and r.m.s value of current, emf with sinusoidal wave form, Reactance, Impedance, Phase angle, power dissipation in AC circuit, Power factor, vector diagram, Faraday's Law, Lenz's Law, Self Inductance and Mutual Inductance, LR, CR and LCR, Resonance, Q-factor -Transformer and motors.

Electromagnetic Waves: Maxwell‘s Equations, Displacement current term, Plane Electromagnetic Waves, Energy Carried by Electromagnetic Waves, Momentum and Radiation Pressure, The Electromagnetic Spectrum.

Learning Resources:

Text Books:

1. Edward M. Purcell, Electricity and Magnetism, Cambridge Press, 2013, Third Edition.

2. D.J. Griffiths, Introduction to Electrodynamics, Cambridge Press, 2017, Fourth Edition.

Reference Books:

1. S.Mahajanand Choudhury, Electricity, Magnetism & Electromagnetic Theory, Tata McGraw Hill, 2012.
2. J.H.Fewkes, Yearwood, Electricity and Magnetism, Vol.I, Oxford Univ. Press, 2005.
3. Ajoy Ghatak, K Thyagarajan, Ravi Varshney, Problems and Solutions in Electromagnetics, Viva Books Private Limited, 2015.

Online Resources:

1. https://ocw.mit.edu/courses/physics/8-022-physics-ii-electricity-and-magnetism-fall-2004/lecture-notes/

2. https://examupdates.in/electricity-and-magnetism-notes/

List of Experiments:

Measurements with a multimeter.

1. Study characteristics of a series RC circuit.
2. Measurement of response curve of a Series LCR circuit and determine the (a) Resonantfrequency, (b) Impedance at resonance, (c) Quality factor Q, and (d) Band width.
3. Measurement of response curve of a parallel LCR circuit and determine the (a) Anti-resonant frequency and (b) Quality factor Q.
4. Measurement of low resistance using Carey foster bridge.
5. Measurement of field strength B and its variation in a solenoid
6. **D**etermine self-inductance of a coil by Anderson's bridge.
7. Verification of superposition and maximum power transfer theorems.
8. Determine self-inductance of a coil by Rayleigh's method.
9. Determine the mutual inductance of two coils by Absolute method.
10. Determination of the resistance of a galvanometer by Kelvin‘s method using P. O box.
11. Study of rise and decay of current in LR circuit with a source of constant EMF.
12. Determination of velocity of sound in air.
13. Study of electromagnetic induction and verification of Faraday‘s law.

Learning Resources:

Text Books:

1. Electricity and Magnestism Lab Manual, Department of Physics, NITW, 2021
2. Indu Prakash, Ramakrishna, A Text Book of Practical Physics, Kitab Mahal, New Delhi, 2011, Eleventh Edition.

CY3202 **3-0-2 (4)**

Physical Chemistry – 1

Pre-Requisites: None

Course Outcomes:
CO-1 Understand the differences among the colligative properties of solutions.
CO-2 Identify the physical states of matter based on their properties
CO-3 Interpret the distribution of solute between two immiscible solvents
CO-4 Apply phase rule to different systems for isolating the components
CO-5 Apply the concepts of colloids and adsorption in commercially viable technologies

Course Articulation Matrix:

PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	2	2	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	1	2	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–

1 - Slightly; 2 - Moderately; 3 - Substantially

Syllabus:

Liquid state and gaseous state: Liquid state: Vacancy theory of liquids, Physical properties of liquids: Vapor pressure, surface tension, Viscosity Gaseous State: Deviation of real gases from ideal behavior, van der Waals equation -Critical phenomenon, Andrew isotherms of CO2 -The law of corresponding states-liquefaction of gases.

Solutions: Liquid-liquid mixtures: Raoult's law, Henry's law, Ideal and Non-ideal solutions, Partially miscible liquids, completely immiscible liquid mixtures- Nernst's distribution law and its Applications.

Phase rule: Components, Degree of freedom, Gibbs Phase rule, Phase equilibria of one component system and two component system.

Colloids and Surface Chemistry: Colloids: Preparation of sols, emulsions, gels, Micelles and reverse micelles, critical micelle concentration; Adsorption and its types, Langmuir theory of unilayer adsorption isotherm, BET isotherm and surface area analysis.

Dilute solutions and colligative properties: Colligative Properties: Lowering of Vapour Pressure, Osmotic Pressure, Elevation in Boiling Point, Depression in freezing point, applications of colligative properties. Abnormal behavior of solutions.

Learning Resources:

Text Books:

1. O. P. Agarwal, Unified Course in Chemistry-3, Jai Prakash Nath Publication, 2018.
2. G.M. Barrow Physical Chemistry, McGraw-Hill Education, 2008, Sixth Edition.
3. S. H. Maron, C. F. Prutton, Principles of Physical Chemistry, Macmillan, 1965, Fourth Edition.

Reference Books:

1. P. Atkins, J. de Paula, W. H. Freeman, Physical Chemistry, 2006, Eighth Edition.
2. S. K. Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer, Netherlands, 2006.
3. A.J. Bard, L.R. Faulkner, Electrochemical Methods: Fundamentals and Applications, Wiley, 2000, Second Edition.
4. K. J. Laidler, J. H. Meiser, Physical Chemistry, Houghton Mifflin Company, Boston, 1999, Third Edition.

Mathematics Major Elective - I

MA3322 **3-1-0 (4)**

Theory of Equations

Pre-Requisites: NIL

Course Outcomes:

At the end of the course, the student will be able to

CO1	Able to solve some of the polynomial equations.
CO2	use the Descartes's rule of sign to find the nature of roots
CO3	Location of the roots of an equation.
CO4	understand Cardon's, Ferrari's and Descartes' method to find roots of cubic and biquadratic equations
CO5	Illuminating sequel to geometry, algebra and analytic geometry.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-3	2	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-5	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

Syllabus:

Graphical representation of a polynomial – Maxima and minima values of polynomials Theorems relating to the real roots of equations - Existence of a root in the general equation - Imaginary roots – Theorem determining the number of roots of an equation – Equal roots – Imaginary roots occurring in pairs - Synthetic division - Diminishing the roots of equation by a given number.

Formation of equation whose roots are functions of the roots of a given equation - Descartes' rule of signs for positive roots - Descartes' rule of signs for negative roots - The fundamental theorem of algebra.

Relations between the roots and coefficients of equation and related theorems - Applications of the theorem - Depression of an equation when a relation exists between two of its roots – The cube roots of unity - Symmetric functions of the roots - Common roots and multiple roots .

Transformation and numerical solution of algebraic equations – Location of the roots of an equation – Binomial and reciprocal equations – Solutions of cubic equations (Cardon's method) - Ferrari's and Descartes' solution of biquadratic equations.

Learning Resources:

Text Books:

1. Theory of equations, H.W. Turnbull, Oliver and Boyd, Edinburgh and London, Interscience Publishers Inc, 1952, 4th Edition.
2. An introduction to the modern theory of equations, Florian Cajori, The Macmillan Company, New York, London, 1919

Reference Books:

1. Theory of Equations, C. C. Mac Duffee, John Wiley, New York; Chapman & Hall, London, 1954.
2. Higher Algebra, Hall and Knight, MacMillan and Co., 1989, 3rd Edition.
3. First Course in the Theory of Equations, Leonard Eugene Dickson, John Wiley & Sons, Inc. New York; Chapman & Hall, London, 1992.

MA3324 **3-1-0 (4)**

Mathematical Logic

Pre-Requisites: NIL

Course Outcomes:

At the end of the course, the student will be able to

CO1	Understand the notion of ordered sets and maps between ordered sets.
CO2	Learn about lattices, modular and distributive lattices, sublattices and homomorphisms between lattices.
CO3	Become familiar with Boolean algebra, Boolean homomorphism, Karnaugh diagrams, switching circuits and their applications.
CO-4	Learn about basics of fuzzy logic and its applications

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-3	2	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	1	2	2	2	–	–	–	–	–	–	–	–
CO-5	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

Ordered Sets
Definitions, Examples and basic properties of ordered sets, Order isomorphism, Hasse diagrams, Dual of an ordered set, Duality principle, Maximal and minimal elements, Building new ordered sets, Maps between ordered sets.

Lattices
Lattices as ordered sets, Lattices as algebraic structures, Sublattices, Products and homomorphisms; Definitions, Examples and properties of modular and distributive lattices, The M3 – N5 theorem with applications, Complemented lattice, Relatively complemented lattice, Sectionally complemented lattice.

Boolean Algebras and Switching Circuits
Boolean algebras, De Morgan's laws, Boolean homomorphism, Representation theorem; Boolean polynomials, Boolean polynomial functions, Disjunctive normal form and conjunctive normal form, Minimal forms of Boolean polynomial, Quine−McCluskey method, Karnaugh diagrams, Switching circuits and applications of switching circuits.

Fuzzy Logic: Many-valued logic, 3-valued logic of Lukasiewich, the truth tables of conjunction, disjunction, negation and implication, tautology and validity, Infinite valued logic, calculation of truth values of the logical connectives.

Applications (brief idea): Applications of Modal Logic in Artificial Intelligence, database theory, distributed system, cryptography. Applications of Fuzzy Logic in Artificial Intelligence, Soft computing, Decision theory, NLP, Pattern recognition.

Learning Resources:

Text Books

1. Davey, B. A., & Priestley, H. A. (2002). Introduction to Lattices and Order (2nd ed.) Cambridge University press, Cambridge.
2. Elliott Mendelson; Introduction to mathematical logic; Chapman & Hall; London, 1997.
3. Lidl, Rudolf & Pilz, Gunter. (2004). Applied Abstract Algebra (2nd ed.) Undergraduate Texts in Mathematics. Springer (SIE). Indian Reprint..

Reference Books:

1. S.C.Kleene; Introduction to Metamathematics; Amsterdam; Elsevier, 1952.
2. J.H.Gallier; Logic for computer science; John.Wiley& Sons, 1987.
3. Rosen, Kenneth H. (2012). Discrete Mathematics and its Applications, with Combinatorics and Graph Theory. (7th ed.). McGrawHill Education. Indian Reprint..

MA3326 **3-1-0 (4)**

Mechanics

CO-1	Develop equations of motion for a system of particles
CO-2	Analyze the motion of a rigid body under translation
CO-3	Explain Euler's theorems for the motions of rigid bodies
CO-4	Analyze the motion of a rigid body under rotation about a fixed point
CO-5	Develop Lagrange's and Hamiltonian equations for body

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	3	3	–	–	2	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	3	–	–	1	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	2	3	3	–	–	1	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	1	–	–	2	–	–	–	–	–	–	–	–	–	–

1 - Slightly; 2 - Moderately; 3 - Substantially

Syllabus:

Coplanar force systems; Threedimensional force systems; Moment of a force about a point and an axis, Principle of moments, Couple and couple moment, Moment of a couple about a line, Resultant of a force system, Distributed force system, Rigidbody equilibrium, Equilibrium of forces in two and three dimensions, Freebody diagrams, General equations of equilibrium, Constraints and statical determinacy.

Friction, Center of Gravity and Moments of Inertia: Equations of equilibrium and friction, Frictional forces on screws and flat belts; Center of gravity, Center of mass and Centroid of a body and composite bodies; Theorems of Pappus and Guldinus; Moments and products of inertia for areas, Composite areas and rigid body, Parallelaxis theorem, Moment of inertia of a rigid body about an arbitrary axis, Principal moments and principal axes of inertia.

Conservation of Energy and Applications: Conservative force fields, Conservation of mechanical energy, Workenergy equations, Kinetic energy and workkinetic energy expressions based on center of mass, Moment of momentum equation for a single particle and a system of particles.

Rigid Body Motion: Translation and rotation of rigid bodies, Chasles' theorem, General relationship between time derivatives of a vector for different references, Relationship between velocities of a particle for different references, Acceleration of particle for different references.

Learning Resources:

Text Books:

1. J. L. Synge and B. A. Griffith, Principles of Mechanics, McGraw Hill, 1987, Third Edition.
2. Hibbeler, R. C. (2016). Engineering Mechanics: Statics & Dynamics (14th ed.). Pearson Prentice Hall (Pearson Education), New Jersey.
3. Shames, Irving H., & Rao, G. Krishna Mohan (2009). Engineering Mechanics: Statics and Dynamics (4th ed.). Dorling Kindersley (India) Pvt. Ltd. (Pearson Education). Delhi.

Reference Books:

1. G. R. Fowles and G. L. Cassiday, Analytical Mechanics, Cengage Learning, 2004, Seventh Edition.
2. Murray R. Spiegel, Theory & Problems of Theoretical Mechanics, Schaum's Outline Series, McGraw Hill, 2017, Reprint of First Edition.
3. F. Chorlton, Textbook on Dynamics, CBS Publication, 2002, Second Edition

Semester – V

ED3301 **3-1-0(4)**

Content cum Pedagogy of Maths at Secondary Stage–II

Course Outcomes:

CO-1	Discuss the nature and functions of various instructional resources.
CO-2	Explore and utilize the teaching learning resources to support pedagogical experiences ofMathematics.
CO-3	Organize and manage supportive activities for development of mathematical aptitude ofsecondary school students.
CO-4	Plan appropriate experiences for teaching Mathematics.
CO-5	Explore diverse backgrounds and interests' children bring to set up the inclusive classroomfor Mathematics learning.
CO-6	Elaborate technological tools for teaching and learning of Mathematics.
CO-7	Integrate technology to judiciously facilitate learning for enhancing inclusive environment.

Syllabus:

Teaching Learning Resources: Teaching learning materials: meaning and importance for secondary school Mathematics,Types of teaching learning resources: print media (Mathematics textbook, teachers' manual/ handbook, laboratory manual), non-print and digital media (charts, 2-D and 3-D models, games, web resources, interactive boards, animations, videos, images, simulations) for offline/ online classroom teaching and learning. Identification and use of learning resources in Mathematics from the local environment, community resources and pooling of resources. Mathematics resource room/ laboratory – equipment and management, concept of virtual laboratories. Organization of Mathematics club, fairs, exhibitions, learner community

Content Analysis and Planning for Teaching Mathematics: Analysis for identification of axioms, concepts, rules, formulas, theorems, corollaries; pedagogical content knowledge of arithmetic, algebra, geometry, mensuration, and trigonometry of secondary stage. Planning and evaluating learning experiences in an inclusive setup based on learning outcomes and competencies, building a community of mathematicians in classrooms. Developing annual plan, unit plan, lesson plan – need, main consideration, and format. Strategies for method-based lesson plan for secondary classes - inductive-deductive,analytical-synthetical, lecture cum demonstration, problem-solving, laboratory, and project based.

ICT Integration and Applications in Teaching of Mathematics: Scope and importance of ICT for teaching and learning Mathematics. Use of ICT (digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources, open education resources, blogs, forums, interactive boards, and devices) in the teaching learning, assessment and resource management of secondary Mathematics. Use of tools, software, and platforms such as GeoGebra, Khan Academy along with national teacher's portal, DIKSHA, SWAYAM. Developing ICT integrated lesson plans using Technological Pedagogical ContentKnowledge (TPCK) for Mathematics classroom and online teaching.

Suggestive Reading Materials:

- NCERT: A Handbook for Designing Mathematics Laboratory in Schools (Code- 1555)
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the need of the learners and learning content

ED3303 **3-1-0(4)**

Content cum Pedagogy of Physical Sciences at Secondary Stage–II

Course Outcomes:

CO-1	Identify teaching learning aids / materials and illustrate their importance in teachinglearning the concepts of Physical Sciences.
CO-2	Categorize teaching aids/materials/learning resources.
CO-3	Develop teaching learning aids/material/kits/learning resources for teaching learning theconcepts of Physical Sciences.
CO-4	Utilize teaching aids/materials/learning resources for teaching learning the concepts ofPhysical Sciences.
CO-5	Analyze the content of physical sciences textbooks at secondary stage.
CO-6	Develop lesson plan based on learning outcomes and experiential learning using appropriate strategies.

syllabus:

Teaching learning aids/materials: concept, definition, role and importance in classroom teaching learning the physical sciences. Types of teaching learning aids/ materials: print media such as textbook, teachers' manual/ handbook, laboratory manual and other print materials, non-print and digital media such as radio, TV, websites, animations, audios, videos, images, simulations, digital repository, Augmented Reality (AR), Virtual Reality (VR) and Artificial Intelligence (AI) based digital resources and Open Educational Resources (OERs) for offline/ online classroom teaching learning reflective journals, charts, 2-D and 3-D models, games, cards, worksheets, multimedia. Identification and use of learning resources in physical sciences from the local environment. Resource room/ laboratory/ library, virtual laboratories, teaching learning kits, physical sciences clubs, fairs, exhibitions, educational parks, excursions, community resources andpooling of resources.

Content Analysis and Planning for Teaching Physical Sciences: Pedagogical analysis of content taking examples from topics of physical sciences textbooks at secondary stage, identification of concepts, listing learning outcomes and competencies, planning, and evaluating learning experiences in an inclusive setup. Concept, types and importance of unit and lesson planning. Developing unit plans and lesson plans based on learning outcomes and experiential learning by selecting topics from textbooks of physical sciences at secondary stage.

ICT Integration and Applications: Scope and importance of ICT in physical sciences. Use of ICT such as Artificial Intelligence, machine learning, smart boards in the teachinglearning, assessment, and resource management. Tools, software, and platforms for teaching learning of physical sciences at secondary stage. Developing ICT integrated lesson plans by taking topics of physical sciences at secondary stage using Technological Pedagogical Content Knowledge (TPCK) for classroom and online teaching.

Suggestive Reading Materials:

- Draft National Curriculum Framework for School Education,
- Laboratory Manual of Science (Grade 9 & 10), NCERT.
- National Education Policy 2020, MoE, Government of India.
- National Steering Committee for National Curriculum Frameworks, (2023).
- NCERT Laboratory Manuals.
- NCERT Textbooks, Chemistry for Class XI and XII.
- NCERT Textbooks, Physics for Class XI and XII.
- NCERT Textbooks, Science for Class IX and XI.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

ED3305 **2-0-0(2)**

ICT in Education

Course Outcomes:

CO-1	Explain the concept, nature, and scope of ICT in education.
CO-2	Describe the importance of open-source software in education.
CO-3	List and explain various approaches to the adoption and use of ICT in education.
CO-4	Describe the importance of various emerging technologies in education.
CO-5	See relationship between the social, economic, and ethical issues associated with the useof ICT.
CO-6	List out the challenges of educational technology in India.
CO-7	Use various technological tools for improving teaching-learning- assessment processes.

Syllabus:

Introduction to (ICT) in Education: Meaning, Nature, importance of Information Technology, Communication Technology & Information and Communication Technology (ICT) and Instructional Technology, Educational Technology and ICT in Education (Difference, Scope of ICT- Teaching, learning, Research & Publication Educational Administration and Assessment), Technology & Engagement: Internet, Collaborative learning through Online DiscussionForums, group assignments & Peer reviews, Meaning and Uses of Systems Approach in instructional design, Models of Development of Instructional Design (ADDIE, ASSURE, Dick and CareyModel Mason's), Flanders' Interaction Analysis Category System (FIACS), Challenges relating to Educational Technology.

Emerging Technologies in Education: E-learning Concept, methods, and media (LMS, Virtual Universities, Massive Open Online Course (MOOCs), Indian MOOCs, Types of MOOCs: cMOOCs, xMOOCs & LMOOCs). Open Education Resources (Creative Commons, Concept, and application). Augmented reality, Virtual reality, Artificial intelligence, Mixed Reality & Gamificationin education (Meaning, history, importance, tools and uses). Cloud Computing & Internet of Things - Meaning, importance and uses. Ethical issues & safety in ICT- (Teaching, Learning and Research, Cyber bullying, Cybersecurity literacy & data protection, Online identity and privacy).

ICT in Teaching-Learning & Assessment: Concept, Approaches to integrating ICT in teaching and learning: Technological Pedagogical Content Knowledge (TPCK), Technology Integration Matrix (TIM). Implication of Learning Theories in ICT in Education: Behaviourism, Cognitivism & Constructivism. Developing functional skills to use discipline specific ICT tools (Geogebra, PhET, Stellarium, Open Street Map, Marble, Turtle Art, Technological tools for Mind mapping etc.). ICT and Assessment- Electronic assessment portfolio – Concept and types; e-portfolio tools. Online and offline assessment tools – Rubrics, survey tools, puzzle makers, test generators, reflective journal, question bank. ICT applications for Continuous and Comprehensive Evaluation (CCE).

Suggestive Reading Materials:

1. Prof. T. Mrunalini & Prof. A. Rama Krishna, Information & Communication Technology (ICT) in Education, Neelkamal, 2016.
2. Bhavana Shukla, Key Perceptions of ICT in Education, Agarwal Publications, 2019, First Edition.
3. P. Satyanarayan, Lakshmi Mantha & C. Sesharatnam, ICT use in Indian Education, Shipra Publications, 2020..

MA3301 **3-1-0 (4)**

Mathematical Analysis

Pre-Requisites: None

Course Outcomes:

CO-1	Know the fundamental principles of real numbers that underpin the formal development of
CO-2	Apply the understanding of the theory of sequences and series
CO-3	Understand the concepts related to metric spaces such as continuity.
CO-4	Apply the mean value theorems and the fundamental theorem of calculus.
CO-5	Adapt with the skills in constructing mathematical arguments

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Sequence and Series of Real Numbers: Equivalence and countability of sets, real numbers, least upper bounds and greatest lower bounds; Sequences of real numbers – convergence and divergence of sequences, bounded and monotone sequences, operations on sequences, limit superior and limit inferior, Cauchy sequences; Series of real numbers – convergence and divergence, series with non-negative terms, alternating series, conditional and absolute convergence of series, rearrangement of series, Tests of absolute convergence – comparison test, ratio test, root test; powers series and radius of convergence; series whose terms form a non-increasing sequence; summation by parts.

Metric Spaces and Continuous Functions: Limit of a function on the real line; metric spaces; point set topology on metric spaces; open sets; closed sets; limits in metric spaces; continuous functions on metric spaces.

Calculus: Definition of Riemann integral; existence; properties of Riemann integral; derivatives; mean value theorems; fundamental theorem of calculus.

Learning Resources:

Text Books:

1. Richard R. Goldberg, Methods of Real Analysis, John Wiley & Sons, Reprint by Oxford and IBH Publishing, 2020, Second Edition.

Reference Books:

1. Robert G. Bartle, Donald R. Sherbert, Introduction to Real Analysis, Wiley India, 2014, Fourth Edition.
2. Ajit Kumar, S. Kumaresan, A Basic Course in Real Analysis, CRC Press, 2016, Special Indian Edition.
3. Tom M. Apostol, Mathematical Analysis, Addison-Wesley, 1974, Second Edition.

CY3301 **3-0-2 (4)**

Physical Chemistry-2

Pre-Requisites: None

Course Outcomes:

CO-1 Identify the unique vocabulary of thermodynamics for explaining the basic concepts associated with it.
CO-2 Apply the laws of thermodynamics to closed and open systems undergoing different thermodynamic processes and evaluate the feasibility of a thermodynamic cycle.
CO-3 Apply the knowledge of electrochemistry in understanding electrochemical energy systems
CO-4 Analyze the types of reactions and theories of reaction rates.
CO-5 Perceive the theories of ionization and electrochemistry for analysing electrochemical processes.

Course Articulation Matrix:

PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	2	2	2	1	–	–	–	–	–	–	–	–	–	–	–
CO-2	2	1	2	2	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	1	1	1	–	–	–	–	–	–	–	–	–	–	–
CO-4	2	2	2	1	–	–	–	–	–	–	–	–	–	–	–
CO-5	2	1	1	2	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; 2 - Moderately; 3 - Substantially

Syllabus:

Thermodynamics: First Law of Thermodynamics: Enthalpy, Heat Capacity, Joule-Thomson Effect, Isothermal Expansion of an Ideal Gas, Thermochemistry, Second Law of Thermodynamics: Spontaneous, Irreversible Process, The Carnot Cycle, Entropy, Helmholtz Free Energy, Gibbs-Helmholtz Equations, Clausius-Clapeyron equation, Van't Hoff Isotherm and Isochore.

Electrochemistry: Kohlrausch Law, Transport Numbers, Arrhenius theory of electrolyte dissociation, ostwald's dilution law, Debye-Huckel Theory of Strong Electrolytes- Debye-Huckel-Onsagar Equation, Activity and Activity coefficients, Ionic strength, Electrochemical Cells and EMF: Nernst equation, Reference Electrodes, Concentration cells, liquid junction potential and its determination, applications of emf measurements, Rechargeable Batteries, Fuel Cells

Chemical Kinetics: Order of a reaction, Effect of Temperature on Reaction Rates. Theories of Reaction Rates: collision theory (mathematical treatment). Collision theory of bimolecular gaseous reactions (overview).

Learning Resources:

Text Books:

1. O. P. Agarwal, Unified Course in Chemistry-3, Jai Prakash Nath Publication, 2018.
2. G.M. Barrow, Physical Chemistry, Tata McGraw-Hill Education, 2008, Sixth Edition.
3. S. H. Maron and C. F. Prutton, Principles of Physical Chemistry, Macmillan, 1965, Fourth Edition.

Reference Books:

1. P. Atkins, J. de Paula, W. H. Freeman, Physical Chemistry, 2006, Eighth Edition.
2. S. K. Upadhyay, Chemical Kinetics and Reaction Dynamics, Springer, Netherlands, 2006.
3. A.J. Bard, L.R. Faulkner, Electrochemical Methods: Fundamentals and Applications, Wiley, 2000, Second Edition.
4. K. J. Laidler, J. H. Meiser, Physical Chemistry, Houghton Mifflin Company, Boston, 1999, Third Edition.

Lab Syllabus:

1. Determination of dissociation constant of a weak acid and verification of Ostwald's dilution law
2. Determination of concentrations of strong acid/weak acid using conductometry
3. Determination of concentrations of strong acid/weak acid by potentiometry
4. Evaluation of Eo values of Zn|Zn2+ and Cu|Cu2+ Electrodes and measurement of emf by constructing the Daniel cell.
5. Determination of the concentration of strong/weak acid by pH metry
6. Measurement of pH of given samples of milk, juice, soap, detergent and shampoo.
7. To study the kinetics of acid hydrolysis of methyl acetate
8. To study the kinetics of acid-catalysed iodination of acetone
9. Iodine Clock reaction
10. Determination of decomposition of hydrogen peroxide in the presence of ferric chloride.
11. Verification of Beer-Lambert's and determination of the concentration of given KMnO4 solution using spectrophotometer
12. Determination of specific rate constant of oxidation of alcohol by potassium dichromate
13. Spectrophotometric Determination of Critical Micelle Concentration.
14. Verification of Freundlich's Adsorption isotherm for the adsorption of acetic acid on charcoal

Learning Resources:

Text Books:

1. Shoemaker D.P., Garland C.W. and Nibler J.W. Experiments in Physical Chemistry, McGraw Hill, 2008, Eighth Edition.
2. S.W. Rajbhoj and T.K. Chondheka, Systematic Experimental Physical Chemistry, Anjali Publication, 2013, Third Edition.

Reference Books:

A. J. Elias, A Collection of Interesting General Chemistry Experiments, Universities
1. Press, 2007, Revised Edition.
2. Alexander Findley, Practical Physical Chemistry, Wiley, 1972, Ninth Edition.
3. R.C. Das, B. Behera, Experiments in Physical Chemistry, McGraw-Hill, 1984.

MA3303 **3-1-0 (4)**

Linear Programming and Applications

Pre-Requisites:

Course Outcomes:

CO-1	Learn about the graphical solution of linear programming problem with two variables.
CO-2	Learn about the relation between basic feasible solutions and extreme points.
CO-3	Understand the theory of the simplex method used to solve linear programming problems.
CO-4	Learn about two-phase and big-M methods to deal with problems involving artificial variables.
CO-5	Learn about the relationships between the primal and dual problems.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Introduction to Linear Programming: Linear programming problem: Standard, Canonical and matrix forms, Graphical solution; Convex and polyhedral sets, Hyperplanes, Extreme points; Basic solutions, Basic feasible solutions, Reduction of feasible solution to a basic feasible solution, Correspondence between basic feasible solutions and extreme points.

Methods of Solving Linear Programming Problem : Graphical Method, Simplex method: Optimal solution, Termination criteria for optimal solution of the linear programming problem, Unique and alternate optimal solutions, Unboundedness; Simplex algorithm and its tableau format; Artificial variables, Two-phase method, Big-M method.

Duality Theory of Linear Programming: Motivation and formulation of dual problem; Primal-Dual relationships; Fundamental theorem of duality; Complimentary slackness.

Applications: Transportation Problem: Definition and formulation; Methods of finding initial basic feasible solutions; Northwest corner rule. Least cost method; Vogel's approximation method; Algorithm for solving transportation problem.
Assignment Problem: Mathematical formulation and Hungarian method of solving.
Game Theory: Basic concept, Formulation and solution of twoperson zerosum games, Games with mixed strategies, Linear programming method of solving a game.

Learning Resources:

Text Books:

1. Bazaraa, Mokhtar S., Jarvis, John J., & Sherali, Hanif D. (2010). Linear Programming and Network Flows (4th ed.). John Wiley and Sons.
2. Hadley, G. (1997). Linear Programming. Narosa Publishing House. New Delhi.
3. Taha, Hamdy A. (2010). Operations Research: An Introduction (9th ed.). Pearson.

Reference Books:

1. Hillier, Frederick S. & Lieberman, Gerald J. (2015). Introduction to Operations Research (10th ed.). McGraw-Hill Education (India) Pvt. Ltd.
2. Thie, Paul R., & Keough, G. E. (2014). An Introduction to Linear Programming and Game Theory. (3rd ed.). Wiley India Pvt. Ltd.

CY3303 **3-0-2 (4)**

Inorganic Chemistry-2

Pre-Requisites: None

Course Outcomes:

CO-1	understand the general chemistry of d and f block elements
CO-2	Understanding the general chemistry of main group elements
CO-3	Learn bonding theories in coordination compounds
CO-4	Interpret the biological importance of organometallic compounds
CO-5	Apply theories of bonding in the interpretation of colour and magnetic properties of coordination compounds

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	–	–	–	–	–	–	–	–	–	–
C-2	3	2	2	2	2	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Transition Metal Chemistry: d-block elements: oxidation state, complex formation, color and magnetic properties, organometallic compounds and their biological importance

Inner Transition Metal Chemistry: Lanthanides and actinides: Oxidation state, separation, physical properties, super heavy elements, Nuclear fuels

Main group Chemistry: Polyhedral boranes and carboranes: structure, bonding and electron count, Isolobal analogy, boron heterocycles, P-N compounds, S-N heterocycles

Coordination Chemistry: Theories of metal-ligand bonding- Valence bond theory and crystal field theory, Limitations, applications

Learning Resources:

Text Books:

1. J. D. Lee, Concise Inorganic Chemistry, Wiley India, 2015, Fifth Edition.
2. Catherine E. Housecroft, A. G. Sharpe, Inorganic chemistry, Pearson, 2018, Fifth Edition.

PH3301 **3-0-2 (4)**

Basic Electronics

Pre-Requisites: None

Course Outcomes:

CO-1	Understand operating principles of electronic components like diode, Zener diode, BJT and
CO-2	Comprehend the functioning and biasing of transistors and study their characteristics
CO-3	Comprehend the I-V characteristics of BJT, FET and J-FET devices
CO-4	Understand functioning of amplifiers and oscillators and be able to design related circuits as well
CO-5	Understand and appreciate number systems and the functioning of basic logic gates

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

PN Junction Diode: Basics, ideal diode, PN junction diode, V-I characteristics, Zener diode, Half, full wave (center tapped and Bridge) rectifiers, RC and LC filters, Design of un-regulated DC power supply, Clipping and Clamping circuits, voltage multiplier circuits.

BJT: Construction and Operation, CE, CB and CC characteristics, DC load line and bias point, fixed, emitter feedback, collector feedback, and voltage divider biasing circuits, Thermal stability, switching circuits, Constant Current sourcs, transistor power dissipation, switching.

Field effect transistors (FET): JFET, Construction, Working, and characteristics, Biasing in ohmic and active regions, Trans-conductance, amplification and switching, MOSFET, CMOS introduction.

Amplifiers and Oscillators: Classification, RC-coupled CE amplifier – frequency response. Feedback circuits, noise, input and output impedances. Emitter follower and Darlington pair. RC oscillators- RC phase shift and Wien's bridge oscillators, LC oscillators- Hartley and Colpitt oscillators.

Digital Electronics: Binary, octal, decimal and hexadecimal number systems, Booleon algebra, -Basic and Universal Gates, Half adder, Full adder and parallel adder logic circuits. Logic families and their characteristics.

Learning Resources:

Text Books:

1. David A. Bell, Electronic Devices and Circuits, Oxford University Press, 2008, Fifth Edition
2. Albert Malvino, David, Electronic Principles, McGraw-Hill, 2016, Fifth Edition.

Reference Books:

1. Robert L. Boylestad, Louis Nashelsky, Electronic Devices and Circuit Theory, Pearson education, 2013, Fifth Edition.
2. Jacob Millman, Chrisots C. Halkias, Satyabrata Jit Millman, Electronic Devices and Circuits, McGraw Hill, 2007, Second Edition.

Online Resources:

1. https://nptel.ac.in/courses/117/103/117103063/
2. https://nptel.ac.in/courses/117/107/117107095/

Experiments:

1. Obtain I-V characteristics of semiconductor rectifier diode, LED, and Photo-diode
2. To observe waveform at the output of half wave rectifier and to measure DC voltage, DC current, ripple factor with and without a filter capacitor
3. To observe waveform at the output of full wave rectifier and to measure DC voltage, DC current, ripple factor with and without a filter capacitor
4. To observe waveform at the output of bridge rectifier and to measure DC voltage, DC current, ripple factor with and without a filter capacitor
5. To construct clamper circuits on breadboard and to observe waveforms at the output of clamper circuits
6. To construct clipper circuits on breadboard and to observe waveforms at the output of clipper circuits
7. To obtain common emitter, common base and common collector characteristics of NPN transistor
8. To design and construct common emitter amplifier circuit on breadboard and to measure gain at different frequencies and to plot the frequency response
9. To understand the working of transistor as a switch. To draw DC load line for given circuit.
10. To observe input-output waveforms of common collector (CC) amplifier and to measure gain of amplifier at different frequencies and to plot the frequency response
11. To obtain characteristics of field effect transistor (FET) and to measure gain of FET common source (CS) amplifier.
12. To construct and verify truth table of basic digital logic gates OR, AND, NOT, NAND, NOR, EX-OR, EX-NO

Learning Resources:

Text Books:

1. Electronics Lab Manual, Department of Physics, NITW,2021
2. Albert Paul Malvino, Patrick Hoppe, David J. Bates, Experiments Manual for Use with Electronic Principles, MCG Hill, 2015

Reference Books:

1. Albert Malvino, David J Bates, Problems and Solutions in Basic Electronics, McGraw Hill Education, 2011, Special Indian Edition.
2. Jacob Millman, Chrisots C. Halkias, Satyabrata Jit, Electronic Devices and Circuits with simulation, McGraw Hill, 2009.

Online Resources:

1. http://vlabs.iitkgp.ac.in/be/

ED3307 **3-0-2 (4)**

Pre-Internship Practice

Pre-Requisites: **None**

Course Outcomes:

CO-1	describe the prerequisites of the internship,
CO-2	demonstrate knowledge of pedagogic practices, classroom management skills, assessment tools and learning standards
CO-3	develop lessons plans and relevant Teaching Learning Materials (TLMs),
CO-4	develop readiness to take up an internship programme

Syllabus:

Suggestive Mode of Transaction

- Demonstration lesson (minimum 1 in each pedagogical subject)
- Peer Group teaching and peer observation (minimum 5 in each pedagogical subject)
- Observation of lessons by teacher educators during peer group teaching
- Reflective group discussions/workshops/seminars
- Preparation and presentation of the video content illustrating best classroom practices.

Content: The pre-internship will include activities relating to the stage-specific pedagogy courses, ability enhancement and value-added courses and foundation courses transacted during previous semesters. It will also include knowledge of pedagogy, formats of lesson plans, different ICT tools, schooling systems in India, principles of classroom management, assessment, and other relevant content.

Activities to be conducted:

- Observation of lessons transacted by teacher educators to identify pedagogic skills.
- Exposure to various types of lesson plans through workshops.
- Development of relevant Teaching Learning Materials (TLMs).
- Participation in screening and discussion of educational videos on pedagogy and assessment.
- Learning about inclusiveness in school education
- Orientation for Action Research/case study

Orientation of student teachers to different pedagogic approaches like storytelling, art-integrated, sports-integrated, project-based, and ICT-integrated for developing critical thinking, attention to life aspirations, and greater flexibility and classroom management skills.

- Observation of the lesson demonstrated by teacher educators/experts in the institute.
- Designing guided activities, including a laboratory for each class/subject based on learning outcomes.
- Study Secondary Stage Learning Standards in the NCF
- Content analysis and development of the unit plan, concept map and lesson plan.
- Discussion on unit plan and lesson plan with teacher educators/experts
- Preparation of a Portfolio (for self-work) that the student-teacher will use to keep all her/his work.
- Participate in discussions/reflective sessions for conceptualizing teaching-learning practices.
- Exploring available learning resources and educational videos
- Developing local, low-cost, and innovative TLM s
- Reading and reflecting on inspiring books on pedagogic practices

Assessment

Competence/Artifact	Method of assessment	Assessed By	Credits
Classroom teaching skills and assessment tools (including learning standards)	Simulated Presentation	Teacher-Educator	1
Reflective group discussions/workshop	Observations	Teacher-Educator	0.5
Artefacts (Lesson Plans, TLM, Curated Videos) and action research procedures.	Evaluation	Teacher-Educator	0.5

Semester – VI

ED3302 **3-1-0(4)**

Content cum Pedagogy of Maths at Secondary Stage–III

Course Outcomes:

CO-1	Analyze the sources of the development of 21st century skills through Mathematics teaching and learning.
CO-2	Determine role of teacher in facilitating learning and creating dynamic learning environment of Mathematics.
CO-3	Describe need for and importance of assessment in the learning process of Mathematics.
CO-4	Develop various types of tests for assessing students learning in Mathematics.
CO-5	Design and develop innovative strategies and techniques for successful inteaching andlearning Mathematics.
CO-6	Conduct school- based research in Mathematics teaching.
CO-7	Explain the various methods of exploring knowledge.
CO-8	Explore innovative ideas for teaching and learning of Mathematics.
CO-9	Assess the steps of action research.

Syllabus:

21st Century Skills for Learning Mathematics: Need for and importance of how to learn 21st century skills such as practicing imagination, spatial visualization, mathematical reasoning, problem solving for learners and teachers of Mathematics. Psychological, sociological, and philosophical perspective of teaching learning and development of Mathematics. Qualities of a Mathematics teacher as professional. Role of a teacher in facilitating learning and creating dynamic learning environment of Mathematics.

Assessment for Learning in Mathematics: Meaning, need and organization of oral, written, and practical assessment inMathematics. Construction of types of questions in Mathematics: objective, short answer, long answer,considerations for the marking different types of questions in Mathematics. Planning and developing teachers made tests in Mathematics - Table of Specification (TOS), question paper setting and preparing answer key. Tools to identify learning difficulties and provide corrective measures in Mathematics, concept of 360◦ assessment, holistic progress card and assessment of mathematical aspects of students.

Research and Innovative Practices in Teaching of Mathematics: Divergent thinking for innovation in psychological, sociological, and philosophical perspectives of Mathematics for quality learning experiences. Innovative practices in Mathematics. Research on issues of gender, class and culture in Mathematics learning and achievement- expectations, attitudes and stereotypes; access to higher Mathematics; interrogating the notion of 'Achievement Gap'; construction of learners' identity in a Mathematics classroom. Recent trends and research related to teaching learning of Mathematics – digital gaming, digital storytelling, using Artificial Intelligence for Mathematics teaching and learning. Action research for solving problems of teaching and learning of Mathematics: meaning, significance, steps, and planning.

Suggestive Reading Materials:

- NCERT (2012). Pedagogy of Mathematics
- NCERT: Manual for Higher Secondary Mathematics Kit (Code- 3165)

*Teachers may also suggest books/readings as per the need of the learners and learning content.

ED3304 **3-1-0(4)**

Content cum Pedagogy of Physical Sciences at Secondary Stage–III

Course Outcomes:

CO-1	Explain the significance of acquiring 21st-century skills for Physical Sciences teaching.
CO-2	Outline the need for and importance of assessment and evaluation in the teaching ofPhysical Sciences.
CO-3	Appraise with various assessment strategies for continuous assessment in reference toteaching of Physical Sciences.
CO-4	Utilize appropriate tools and techniques for assessment and evaluation in teaching learning of Physical Sciences.
CO-5	Identify recent trends in research related to the teaching and learning and its implicationsin teaching learning of Physical Sciences.
CO-6	Prepare unit test item based on TOSS and develop different types of test items.
CO-7	Construct and administer different type of tests.
CO-8	Plan offline and online activities for testing higher order thinking skills in teachinglearning of Physical Sciences.
CO-9	Relate ICT integration and elaborate its use in classroom situations.
CO-10	Identify a problem in the context of Physical Sciences teaching learning and plan action research.

Syllabus:

21st Century Skills for Learning: Need for and importance of how to learn 21st century skills for learners and teachers ofPhysical Sciences. Psychological, sociological, and philosophical perspective of teaching and learningPhysical Sciences. Qualities of a Physical Sciences teacher as professional for enhancing teaching learningskills. Role of a teacher in facilitating learning and creating dynamic learning environment ofPhysical Sciences

Assessment and Evaluation: Assessment and evaluation: need for and importance of Physical Sciences. Assessment based on learning outcomes, strategies for continuous assessment, school- based assessment, qualitative assessment; formative and summative assessment, formal, informal and 360◦ assessment. Performance assessment: assessment of group activities, field observations, recording and reporting, creating platform and portfolio management, assessment of laboratory skills, assignments, projects, and presentations. Tools and techniques of assessment and evaluation - unit test based on Table of Specification (TOS) and its importance, basic steps of question paper setting, types of testitems and preparing answer key and criteria for school, assessment, and feedback mechanism in teaching learning the content of Physical Sciences.

Research and Innovative Practices in Physical Sciences: Divergent thinking and innovation in psychological, sociological, and philosophicalperspectives for quality learning experiences. Recent trends in research related to teaching learning of Physical Sciences. Action research: meaning, significance, steps and planning. Evidence-based practices and reflection, school-based research in Physical Sciences.

Suggestive Reading Materials:

- National Council of Educational Research and Training. (April 2022). Mandate documents Guidelines for the development of National Curriculum Frameworks.
- National Education Policy 2020, MoE, Government of India
- National Steering Committee for National Curriculum Frameworks, (2023). Draft National Curriculum Framework for School Education.

*Teachers may also suggest books/readings as per the need of the learners and learning content.

ED3306 **2-0-0(2)**

Assessment & Evaluation

Course Outcomes:

CO-1	Use different approaches to assess and evaluate of student performance such as time-constrained examinations; closed/open-book tests; problem-based assignments; practical assignment reports; observation of practical skills; individual and group project reports; oral presentations; viva voce interviews; computerized adaptive testing; peer and self- assessment etc.
CO-2	Develop and use informal and formal diagnostic, formative, and summative assessment strategies to monitor student learning levels and help the teacher continuously revise teaching-learning processes to optimize learning and development for all students.
CO-3	Develop an understanding among student teachers of the approaches to provide timely, effective, and appropriate feedback to students about their performance relative to the expected learning outcomes and organizing learning enhancement initiatives that are required to bridge the gap in student learning levels.
CO-4	Present report on student achievement, making use of accurate and reliable records etc.
CO-5	Develop assessment "as", "of", and "for" learning that are aligned to the expected learning outcomes.
CO-6	Design the progress card of students based on school-based assessment to make it a holistic, 360-degree, multidimensional report that reflects the progress as well as the performance of learners assessed through self-assessment and peer assessment, project- based and inquiry-based learning, quizzes, role plays, group work, portfolios, etc., along with teacher assessment that would provide students with valuable information on their strengths, areas of interest, and needed areas of improvement.

Syllabus:

Assessment and Education Meaning and significance of assessment and evaluation in educational field. Conceptual Clarity and purpose of Measurement, Assessment, Examination,Appraisal and Evaluation in Education. Learning outcomes across the stages and assessment. Taxonomy of Objectives (Revised in 2001) and Implications.

Forms of Assessment:Formative, Summative, diagnostic, prognostic.Internal and External assessment. Assessment For learning, of learning and as learning. Authentic Assessment; Online Assessment.Improving Assessment and Evaluation in Schools: Brief Historical Review (1975, 1988,2000, 2005, 2020)

Process of Assessment and Evaluation: Formative and Summative Assessment: Concept and Characteristics. Approaches to assess and evaluate student performance such as time-constrained examinations; closed/open-book tests; problem-based assignments; practical assignment reports; observation of practical skills; individual and group project reports; oral presentations; viva-voce interviews; computerized adaptive testing; peer and self- assessment etc. Assessing Higher Order Thinking Abilities: Problem solving, critical thinking, creative thinking, communication skills, judgement and decision making, ethical and moral reasoning.

Tools and Techniques: Observation, rating scale, check list, anecdotes, interviews. Assessment of attitudes and interests. Socio-metric techniques. Criteria for assessment of social and personal behaviour. Self-assessment and Peer Assessment.

Analysis and Interpretation: Analysis of students' performance and scores: credit and grading, Graphical representation (Histogram, Frequency Curves), Interpretation of student's performance based on the analysis and their further uses in improving learner's performance: credit and grading, constructive feedback, Reporting student's performance: 360-degree progress reports, cumulative records and their uses, portfolios, PTA meetings, qualitative reporting based on the observations, descriptive indicators in report-cards.

Suggestive Reading Materials:

1. Sunita Agarwalla, Measurement and Evaluation in Education, Mahaveer Publications, 2021.
2. Susan M Brookhart & James H. Mcmillan, Classroom assessment and Educational Measurement, NCME, 2019.

ED3308 **2-0-0(2)**

Inclusive Education

Course Outcomes:

CO-1	Ensure inclusion and equal participation in education of children with disabilities in the regular schooling process that allows students with and without disabilities learn together, ensuring their retention in the school system, and enabling them to achieve the defined learning outcomes.
CO-2	Adapt teaching and learning process to meet the learning needs of different students with disabilities, including providing education and opportunities for participating in arts,sports, and vocation-related activities, making school buildings and compounds as well asother facilities barrier free and accessible for children with disabilities, supporting activities that help the provision of individualized learning environment and learning activities/resources, making available assistive devices and appropriate technology-based tools, as well as adequate and language-appropriate teaching-learning materials (e.g., textbooks in accessible formats such as large print and Braille) to help children with disabilities integrate more easily into classrooms and engage with teachers and theirpeers, using appropriate modes and means of communication, detecting specific learning disabilities in children at the earliest and taking appropriate measures to overcome them, monitoring completion of education and learning levels of students with disabilities etc.

Syllabus:

Inclusion and Education: Conceptual Clarity, relation, and significance with special reference to: UNCRPD, 2006 and RPWD Act, 2016, With special reference to Indian Context. Clarity of various terms and phrases associated with Inclusive Education: Integrated Education, Special Education, Impairment and Disability, Assessment andEvaluation, Curriculum, adaptation, modification and differentiation, universal design of learning. Shifting from Disability to the Inclusive view. Shifting Paradigms from Bio centric to Human Rights. Introductory reference of Policies/Acts with reference to educational implications for Children with Disabilities: Right to Education Act, 2009/ 2012, RPWD Act, 2016, UNCRPD, National Trust Act, 1999, National Educational Policy, 2020.

Children with Disabilities and Marginalized Groups: Nature and needs of children with sensory impairments: cognitive impairments andintellectual disability, physical disabilities, cerebral palsy, multiple disabilities. Specific needs of children with behavioral, emotional learning disabilities. Health Problems. Educational needs of children belonging to Marginalized Groups.

Pedagogical Issues: Conceptual clarity and significance. Meeting the specific needs of Children with Disabilities with special reference to: education and opportunities for participating in arts, sports, and vocation-relatedactivities,making school buildings and compounds as well as other facilities barrier free andaccessible. supporting the learning activities and resources for individualized learningenvironment, making available assistive devices and appropriate technology-based tools, language-appropriate teaching-learning materials (e.g., textbooks in accessibleformats such as large print and Braille) assessing strategies. Designing strategies assessment for inclusive classrooms.

Suggestive Reading Materials:

1. Yukti Sharma, Inclusive Education, Pearson, 2021.
2. Neena Dash, Inclusive Education for Children with special needs, Atlantic, 2023.
3. Jayanta Mete, Prarthina Biswas & Pranay Pandey, Creating an inclusive school, Rita Book Agency, 2020..

ED3310 **2-0-0(2)**

Mathematical & Quantitative Reasoning

Course Outcomes:

CO-1	Adapt mathematical reasoning to solve problems in the real world and explain some fundamental ideas and tenets in this field.
CO-2	Analyze and interpret quantitative data.
CO-3	Interpret & deduce the right conclusions from numerical representations like formulas, graphs, or tables.
CO-4	Demonstrate critical thinking and problem-solving skills using mathematical and quantitative reasoning methods,
CO-5	Evaluate operational matrix.
CO-6	Analyze educational data and create educational model & use them in decision making.
CO-7	Analyze and evaluate mathematical and quantitative reasoning problems and solutions.

Syllabus:

Introduction to mathematical and quantitative reasoning: Meaning, nature and scope of mathematical and quantitative reasoning. Importance of mathematical and quantitative reasoning in various fields. Types of quantitative reasoning. Usage of mathematical and quantitative reasoning. Concept of mathematization.

Introduction to data in Education: Data requirement, different sources of data. School enrolment: gross enrolment ratios, net enrolment ratios, educational progression:dropout rate, literacy: measures of literacy. Indian censuses, details of different items on which Indian censuses collect data. Nationwide sample surveys, National family health survey, District level householdsurvey, UDISE

Data Analysis & Interpretation: Concept of data interpretation (equation, diagram, graph, tables) Statistical analysis of data in educational context and its applications (measures of centraltendency, measures of variability, percentile)**,** Visual and numerical representation of data and its application (bar diagram, histogram,pie charts)**,** Learning analytics: concept, significance, types, levels, and its applications in educationalcontext.

Suggestive Reading Materials:

1. R. S. Aggrawal, Quantitative Aptitude, S. Chand, 2017.
2. Quantitative Aptitude, Pinnacle, 2024.
3. Sarvesh K verma, Quantum CAT, Arihant, 2024, Fourteenth Edition.
4. Data Analysis & Interpretation, Disha, 2019.

ED3312 **1-0-2(2)**

School Observation (Field Practice)

Pre-Requisites:

Course Outcomes:

CO-1	describe various schooling systems,
CO-2	describe the processes, practices, and overall environment of the school,
CO-3	establish rapport with the stakeholders of the school system state the process of conducting different activities in the school,
CO-4	describe the available school infrastructure (classrooms, libraries, laboratories, playground, sanitation, drinking water facility, mid-day meal facility, inclusive facilities, safety and security, rainwater harvesting),
CO-5	describe the availability and usage of ICT and TLMs,
CO-6	summarize the available documents in both physical and digital modes, including UDISE data,
CO-7	reflect upon relationships among the stakeholders,
CO-8	analyze various assessment processes adopted in different types of schools,
CO-9	prepare and present a comprehensive profile of the schools observed (including classroom processes).

Syllabus:

As school is the heart of the teacher education programme, the student teachers need to gain hands-on experiences from various activities organized by the school. School observation offers an opportunity to learn the processes and practices in a school setup. To expose the student teachers to various schooling systems (urban, rural, tribal, residential, non-residential, government, private, affiliated to different school boards like Central Board, State Board, International Board) prevailing in the country. School observation will also prepare the student teachers to build relationships with various stakeholders. The school observation by the student teachers is aimed at helping them build perspective in the schooling system, student needs, pedagogies, and assessment.

The school observation as a field-based activity will cover observation of school and classroom processes. The student teachers under the mentorship of teacher educators will visit schools, interact with teachers and students and other stakeholders, and relate the observation with the courses studied during the previous semesters, i.e. Foundations of Education, Disciplinary Courses, Pedagogy courses and Ability Enhancement & Value-Added Courses.

- Meaning and Nature of school observation process
- Difference between monitoring and observation
- Theory and practices of school observation components such as:
    1. Schooling system
    2. Rapport with all the stakeholders
    3. Office management procedures of different types of schools
    4. School environment in all perspectives
    5. Process of conducting curricular activities in the schooling process
    6. Existing infrastructure available in the school
    7. Utility of ICT and TLM facilities
    8. Interpersonal relationships among the stakeholders

9. Various assessment processes adopted in different types of schools.
10. Engagement of parents and other community members in school activities

Activities to be conducted.

- Visit three types of secondary schools with observation formats developed in the institute and get acquainted with various schooling systems. Establish rapport with all stakeholders.
- Collect information about the demography of students in classes IX to XII and understand the linkage of the secondary stage with the middle stage and higher education through interaction with teachers, students and staff.
- Observe school processes and transactions of the curriculum through experiential learning and prepare a report.
- Interact with teachers and students and report on implementing ten bag-less days and internship opportunities to learn vocational subjects.
- Study the available opportunities for learning interdisciplinary subjects.
- Observe the availability and usage of library resources, laboratories (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports facilities, and art and music learning facilities.
- Study the provision of other student support services- guidance and counselling, NCC, NSS, health and wellness programme.
- Observe the organization of various activities like classroom teaching-learning processes, laboratory activities, library activities, sports and games, debate/elocution/essay writing and other competitions.
- Interact with School heads and subject teachers to understand how students are evaluated by following different tools and techniques of evaluation, how examinations are conducted, how answers are assessed, and how the result is communicated to parents in at least two different types of schools.

Assesment

Competence/Artifact	Method of assessment	Assessed By	Credits
Involvement and active participation during the school visit	Observations	Teacher Educator	0.5
Comprehensive school profile	Presentation & reflection	Teacher-Educator	1.5

Components for school observation report

- School information (Context, Vision and Mission, Association with the Board)
- School Infrastructure
- Provision for CWSN/Divyang Childre
- Inclusiveness at all levels
- Teacher-Student Ratio
- Teaching-Learning process
    - Academic plan
    - Classroom activities
    - Assessment
- School Development Plan (SDP)

- Academic Calendar
- Administrative processes
    - Maintenance of students' records
    - Maintenance of teachers' records
- Cultural activities
- Sports activities
- Annual Day
- National and Social functions
- School Management
- School Discipline
- Interpersonal Relationships
- Understanding different types (socio-economic status, ability) of students and their needs
- Development of ICT and TLMs
- Engagement of parents and community members in the school activity
- Office Management
- The assessment process includes provision and practices for 360-degree holistic assessment.
- The overall progress of the school (planning, organizing, staffing, directing, motivating and controlling)
- Challenges faced and overcoming them.

MA3302 **3-1-0 (4)**

Vector Calculus

Pre-Requisites:

Course Outcomes:

CO-1	Find the derivative along a curve and directional derivatives.
CO-2	Evaluate and interpret gradient, divergence, curl and their related vector Identities
CO-3	Familiar with line, surface and volume integrals along with its applications
CO-4	Use theorems of Gauss, Green and Stokes to compute integrals.
CO-5	Addresses some of the problems of physics and engineering

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	–	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Vector differentiation: Introduction - Scalar and vector valued point functions, Derivatives, Curves, Tangents and length, Velocity and acceleration, Curvature and torsion of a curve, Level surfaces. Gradient of a scalar field and its geometrical interpretation, Directional derivative, Divergence of a vector field and its applications, Curl of a vector field and its applications, Vector identities.

Vector integration: Line integrals, Line integral independent of path, Work done by force, Circulation, Double Integrals, Green's theorem in the plane, Surfaces and surface integrals, Triple integrals, Divergence theorem of Gauss, Stoke's theorem, Proofs and problems based on these theorems.

Curvilinear Coordinates: Orthogonal curvilinear coordinates, Conditions for orthogonally fundamental triad of mutually orthogonal unit vectors. Gradient, Divergence, Curl and Laplacian operators in terms of orthogonal curvilinear coordinates, cylindrical polar coordinates and Spherical polar coordinates.

Learning Resources:

Text Books:

1. Shanti Narayan, P.K. Mittal, A Textbook of Vector Calculus, S Chand & Co Ltd, 2005.
2. Harry F. Davis, Arthur David Snider, Introduction to vector analysis, Allyn and Bacon Inc, Boston, 1975, Third Edition.

Reference Books:

1. Joseph George Coffin, Vector Analysis: An Introduction to Vector-Methods and Their Various Applications to Physics and Mathematics, John Wiley & Sons, Inc., 1911, Second Edition.

2. P.C.Matthews, Vector Calculus, Springer Undergraduate Mathematics Series, Springer-Verlag London, 1998, First Edition.
3. Murray Spiegel, Seymour Lipschutz and Dennis Spellman, Vector Analysis, Schaum's Outlines Series, 2017, Second Edition.

PH3302 **3-1-0 (4)**

Modern Physics

Pre-Requisites: None

Course Outcomes:

CO-1	Understand the main aspects of the inadequacies of classical mechanics as well as understanding of the historical development of quantum mechanics.
CO-2	Describe the main features of Schrodinger equation and the idea of probability interpretation associated with wave-functions.
CO-3	Apply the basic properties of nuclei like density, size, binding energy, nuclear
CO-4	Forces and structure of atomic nucleus, liquid drop model and nuclear shell model and mass formula.
CO-5	Estimate the decay rates and lifetime of radioactive decays like alpha, beta, gamma decay.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	1	–	–	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–
CO-4	3	2	2	1	–	–	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	2	–	–	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Failures of classical mechanics- Quantum theory of Light, Planck's quantum, Planck's constant and light as a collection of photons, Photo-electric effect and Compton scattering, Problems with Rutherford model-instability of atoms and observation of discrete atomic spectra.

Wave Particle Duality, matter waves and De Broglie wavelength; Davisson-Germer experiment. wave packets. Superposition of two waves, Group and Phase velocities. Heisenberg Uncertainty Principle, Illustration of the Principle through Experiments. Two slit interference experiment with photons, atoms & particles, eigen values and eigen functions, normalization; Schrodinger equation-particle in a box, Particle in finite potential well-Quantum mechanical tunneling.

Size and structure of atomic nucleus and its relation with atomic weight; Impossibility of an electron being in the nucleus as a consequence of the uncertainty principle. Nature of nuclear force, N-Z graph,semi-empirical mass formula and binding energy.

Stability of the nucleus; Law of radioactive decay; Mean life and half-life; Alpha decay; Beta decay: energy released, spectrum and Pauli's prediction of neutrino; Gamma ray emission, energy-momentum conservation: electron-positron pair creation by gamma photons in the vicinity of a nucleus. Fission and fusion: mass deficit, relativity and generation of energy; Classification of Elementary Particles.

Learning Resources:

Text Books:

1. Arthur Beiser, Concepts of Modern Physics, McGraw-Hill, 2015, Fifth Edition.
2. E.H. Wichman, Quantum Physics, Berkeley Physics, Vol.4, 2008, Tata McGraw-Hill Co.

3. R.A. Serway, C.J. Moses, C.A.Moyer, Modern Physics, Cengage Learning, 2005.

Reference Books:

1. Fishbane and Gasiorowicz, Modern Physics – Bernstein, Pearson Education, 2015, Fourth Edition.
2. J.R. Taylor, C.D. Zafiratos, M.A. Dubson, Modern Physics, PHI Learning, 2012, Third Edition.
3. R. Gautreau, W. Savin, Theory and Problems of Modern Physics, Schaum`s outline, TMH, 2011, Second Edition.

Online Resources:

1. http://web.sbu.edu/physics/courses/physics-203p.pdf
2. https://drive.google.com/file/d/1OPregBXJ2ldBYeoWh1v9KCxQwzvzlYqY/view
3. http://higgs.physics.ucdavis.edu/9D_part1.pdf

Mathematics Major Elective - II

MA3322 **3-0-2 (4)**

Integral transforms with applications

Pre-Requisites: **None**

Course Outcomes:

CO1	Evaluate Laplace transforms of certain functions, find Laplace transforms of derivatives and of integrals..
CO2	Determine properties of Laplace transform which may be solved by application of special functions namely Dirac delta function, error function, Bessel function and periodic function.
CO3	Understand properties of inverse Laplace transforms, find inverse Laplace transforms of derivatives and of integrals..
CO4	Solve ordinary differential equations with constant/ variable coefficients by using Laplace transform method..
CO5	Comprehend the properties of Fourier transforms and solve problems related to finite Fourier transforms

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2	PSO3	
CO1	2	3	3	2	-	-	-	-	-	-	-	-	-	2	3	
CO2	3	2	3	1	-	-	-	-	-	-	-	-	3	2	–	
CO3	3	3	2	3	-	-	2	-	1	-	-	-	2	-	3	
CO4	2	-	2	2	-	-	-	-	-	-	-	-	3	2	–	
CO5	2	-	3	1	2	-	-	-	2	-	2	-	-	2	3	

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Laplace transforms: Definition of Laplace transform, linearity property-piecewise continuous function. Existence of Laplace transform, functions of exponential order and of class A, First shifting theorem, second shifting theorem and change of scale property.

Laplace Transform of the derivatives, initial value theorem and final value theorem. Laplace transforms of integrals. Laplace transform of tn. f (t), division by t, evolution of integrals by Laplace transforms. Laplace transform of some special functions-namely Dirac delta function, error function,
Bessel function and Laplace transform of periodic function. \\

Inverse Laplace transforms: Definition of Inverse Laplace transform, linear property, first shifting theorem, second shifting theorem, change of scale property, use of partial fractions. Inverse Laplace transforms of derivatives, inverse, Laplace transforms of integrals, multiplication by powers of ‘p’, division by ‘p’. Convolution, convolution theorem proof and applications.

Applications of Laplace transforms: Solutions of differential equations with constants coefficients, solutions of differential equations with variable coefficients. Applications of Laplace transforms to integral equations-Abel’s integral equation. Converting the differential equations into integral equations, converting the integral equations into differential equations.

Fourier transforms: Integral transforms, Fourier integral theorem (without proof), Fourier sine and cosine integrals. Properties of Fourier transforms, change of scale property, shifting property, modulation theorem. Convolution. Convolution theorem for Fourier transform, Parseval’s Identify, finite Fourier transforms.

Learning Resources:

Text Books:

1. A.R. Vasistha, Dr. R.K. Gupta, Laplace Transforms, Krishna Prakashan Media Pvt. Ltd. Meerut.
2. M.D.Raisinghania, H.C. Saxsena , H.K. Dass, Integral Transforms, S. Chand & Company Pvt. Ltd., Ram Nagar, New Delhi-11005.

Reference Books:

1. J.K. Goyal, K.P. Gupta, Laplace and Fourier Transforms, Pragathi Prakashan, Meerut.

MA3324 **3-1-0 (4)**

Descriptive Statistics

Pre-Requisites: **None**

Course Outcomes:

CO-1	It explains the important concepts of statistics and statistical data.
CO-2	Discuss the importance and uses of central values and dispersions for the various types of data
CO-3	measure the various measures of averages and scatteredness of the mass of data in a series. .
CO-4	Explain about the lack of symmetry, rth moments and peakedness of the frequency distributions
CO-5	Study of non-linear and consistency of the data.

Measures of Central tendency: Introduction-Definitions-Types - Mean-Median-Mode-Geometric mean-Harmonic Mean-Weighted mean - Merits and Demerits-Measures of Dispersion: Introduction – Definition – Types – Range - Quartile deviation - Mean deviation - Standard deviation - Co-efficient of variation – Lorenz curve - Merits and Demerits.

Skewness: Introduction-Definition-Types-Karl Pearson's – Bowley's - Kelly's methods – Their merits and demerits. Kurtosis: Introduction-Definition-Types-Its merits and demerits. Moments: Introduction - Definition-Types - Raw, Central moments and their relations

Correlation analysis: Introduction - Definition - Types – Ungrouped and Grouped data – Probable error – properties - Rank correlation – Partial and Multiple correlations - Regression analysis: Introduction - Definition – Regression Equations -Multiple regression - Principle of least squares for first degree, Second degree, Exponential and Power curves

Theory of Attributes: Introduction – Definition-Classes and Class frequencies-Consistency of data-Independence of attributes-Association of attributes-Yule's coefficient and -Coefficient of Colligation.

Learning Resources:

Text Books:

1. Gupta S.C. and Kapoor V.K (2015): Fundamentals of Mathematical Statistics, Sultan Chand & Sons.

Reference Books

1. Rohatgi, V.K. (1984): An introduction to probability theory and mathematical statistics.
2. Hogg. R.V. and Craig. A.T. (1978) : Introduction to Mathematical Statistics, McGraw Hill Publishing Co. Inc. New York.
3. Mood A.M. Graybill, F.A. and Bose. D.C. (1974): Introduction to the theory of Statistics, McGraw Hill Publishing Co. Inc. New York.
4. Sanjay Arora and Bansilal (1989): New Mathematical Statistics, Satyaprakashan, New Delhi

Online Source:

1. https://ocw.mit.edu/courses/mathematics/18-440-probability-and-random-variables-spring-2014/

MA3326 **3-1-0 (4)**

Mathematical Finance

Pre-Requisites: **None**

Course Outcomes:

CO-1	Know the basics of financial markets and derivatives including options and futures..
CO-2	Learn about pricing and hedging of options, as well as interest rate swaps.
CO-3	Learn about noarbitrage pricing concept and types of options.. .
CO-4	Learn stochastic analysis (Ito formula, Ito integration) and the Black−Scholes model.
CO-4	Understand the concepts of trading strategies and valuation of currency swaps.

Syllabus:

Interest rates, Types of rates, measuring interest rates, zero rates, Bond pricing, Forward rate, Duration, Convexity, Exchange traded markets and OTC markets, Derivatives forward contracts, Futures contract, Options, Types of traders, Hedging, Speculation, Arbitrage.

Mechanics and Properties of Options: No Arbitrage principle, Short selling, Forward price for an investment asset, Types of options, Option positions, Underlying assets, Factors affecting option prices, Bounds on option prices, Putcall parity, Early exercise, Effect of dividends.

Stochastic Analysis of Stock Prices and Black Scholes Model: Binomial option pricing model, Risk neutral valuation (for European and American options on assets following binomial tree model), Lognormal property of stock prices, Distribution of rate of return, expected return, Volatility, estimating volatility from historical data, Extension of risk neutral valuation to assets following GBM, Black−Scholes formula for European options.

Hedging Parameters, Trading Strategies and Swaps: Hedging parameters (the Greeks: Delta, Gamma, Theta, Rho and Vega), Trading strategies involving options, Swaps, Mechanics of interest rate swaps, Comparative advantage argument, Valuation of interest rate swaps, Currency swaps, Valuation of currency swaps.

Learning Resources:

Text Books:

1. Hull, J. C., & Basu, S. (2010). Options, Futures and Other Derivatives (7th ed.). Pearson Education. New Delhi.

Reference Books:

1. Luenberger, David G. (1998). Investment Science, Oxford University Press. Delhi. Ross, Sheldon M. (2011).
2. An elementary Introduction to Mathematical Finance (3rded.). Cambridge University Press. USA.

Chemistry Elective - I

CY3322 **3-0-0 (3)**

Instrumental Analysis for Industrial Applications

Pre-Requisites: **None**

Course Outcomes:

CO-1	Explain the theoretical principles behind the instrumental techniques and their applications.
CO-2	Model concepts and techniques in instrumental analysis independently towards industrial applications.
CO-3	Analyze instrumental results for deriving conclusions with relevance to experimental evidences.
CO-4	Assess the appropriateness of an instrumental method for the analysis of samples in various formats and from complex matrices.
CO-5	Design experimental methodology for determining analytes of interest of domestic and industrial applications.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	**3**	**2**	**2**	**2**	**1**	**2**	–	–	–	–	–	–	–	–	–	–
CO-2	3	**2**	2	2	2	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	**2**	1	2	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

UV-Visible Spectrophotometry and Fluorescence: Overview of bioorganic chemistry- historical connection between organic and biological chemistry; weak interactions in organic Beer-Lambert's law, Instrumentation of Absorption Spectrophotometer, Quantitative analysis, limitations, Enzyme linked immunosorbent analysis (ELISA), Molecular fluorescence, influencing factors, basic instrumentation, standardization, quantitative methods, Applications,Diagnostics of biomarkers.

Thermoanalytical methods: Thermogravimetry, Differential thermal analysis, differential scanning calorimetry, Principle, Block diagram, Applications.

Chromatography methods: Gas chromatography, High performance liquid chromatography, size exclusion chromatography, Principle, Basic instrumentation, terminology, NPC, RPC,Qualitative and Quantitative applications, Capillary Electrophoresis: Principle and application.

Surface area and Particle size Analyses: BET- Principle, Pore width, particle size and surface area analysis, Dynamic light scattering – Principle, instrumentation and applications.

X-ray spectroscopic and diffraction methods: X-ray absorbance and fluorescence, Principle, instrumentation, quantitative analysis. X-ray diffraction, Principle, Crystal structure and size analyses. Medical diagnostics, Analysis of geological samples and ores.

Microscopic methods: SEM, Principle, Sample preparations, Surface morphology and particle size analysis, TEM, Principle, Sample preparation, Surface morphology, and Structural determination of nanoparticles. Metal and non-metal nanocomposites, industrial materials.

Atomic spectrometry and atomic absorption: Atomization, Flame atomic emission and absorption, flame emission photometer, flame absorption spectrometer, spectral interferences, and quantitative aspects. Analysis of geological samples and ores.

Electroanalytical methods: Ion selective electrodes, Electrochemical sensors, Ion selective and Potentiometric sensors, Amperometry, Principles, Applications.

Learning Resources:

Text Books:

1. Douglas A. Skoog, F. James Holler, Stanley R. Crouch, Principles of Instrumental Analysis, Cengage Learning India, 2020, 7th Edition.
2. Russel S. Drago, Physical Methods for Chemists, Saunders College Publishing, 2016, 2nd Edition.

Reference Books:

1. D. L. B. Wetzel, George Charalambous, Instrumental Methods in Food and Beverage Analysis (Developments in Food Science), Elsevier, 1998.
2. Michael D. Cole, The Analysis of Controlled Substances (Analytical Techniques in the Sciences (AnTs), Wiley, 2003.
3. Erno Pungor, G. Horvai, A Practical Guide to Instrumental Analysis, CRC Press, 2020.

CY3324 **3-0-0 (3)**

Applied Organic Chemistry

Pre-Requisites: **None**

Course Outcomes:

CO-1	Apply the theoretical knowledge of organic chemistry for the synthesis of molecules with industrial importance
CO-2	Use the knowledge of organic chemistry in paint, agriculture, and cosmetic industry
CO-3	Understand the essentials of organic chemistry in drug synthesis
CO-4	Use the knowledge of organic chemistry for the development of sustainable synthetic processes
CO-5	Apply the knowledge of organic chemistry in food industry

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	3	2	2	2	3	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	3	3	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	3	3	2	3	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	3	2	3	–	–	–	–	–	–	–	–	–	–
CO-5	2	3	1	3	1	2	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Paints, Varnishes and Soaps: **Paints & Varnishes:** Primary constituents of paints, Dispersion medium (solvent), binder Pigments, formulation of paints and varnishes. Requirements of a good paint.

Surface Coatings: Objectives of coatings surfaces, preliminary treatment of surface, classification of surface coatings. Paints and pigments-formulation, composition and related properties. Oil paint, Vehicle, modified oils, Pigments, toners and lakes pigments, Fillers, Thinners, Enamels, emulsifying agents. Special paints (Heat retardant, Fire retardant, Eco-friendly paint, Plastic paint), Dyes, Wax polishing, Water and Oil paints, additives. **Soaps:** manufacture of soaps by hot and cold process, classification of soaps, cleansing of soap and classification of detergents (anionic and cationic).

Fertilizers and Pesticides: **Fertilizers:** natural fertilizers, nitrogenous fertilizer (NH_4NO_3, urea), phosphatic fertilizer (superphosphate, TSP, polyphosphate), potash fertilizer (KCl, KNO_3, K_2SO_4), bio fertilizers.

Pesticides: classification, structure of some important pesticides (DDT, BHC, allethrin and pyrethrin).

Insecticides: Pesticides – classification of Insecticides, fungicides, herbicides as organic and inorganic – general methods of application and toxicity. Safety measures when using pesticides.

Insecticides: Plant products – Nicotine, pyrethrin – Inorganic pesticides – borates. Organic pesticides – D.D.T. and BHC. **Fungicides and Herbicides:** Fungicide: Sulphur compounds, Copper compounds, Bordeaux mixture. Herbicides: Acaricides – Rodenticides. Attractants – Repellents. Preservation of seeds.

Chemistry of Essential oils, Perfumes and Cosmetics: **Essential oil:** Definition–occurrences–Methods of production from plants–Steam distillation and expression method. **Perfumes:** Formulations–Requirements for a good perfume–Compositions of perfumes–classification of perfumery materials–animals-synthetic formulations–manufacturing and packaging process of perfumes. **Cosmetics:** Face cream–Sun screen lotion–shaving cream–composition and formulation–Uses and hazards, Sprayer–Hand lotion–nail lacquers–nail bleaches–hair oil–hair dyes–composition and formulations–Uses and hazards

Chemistry of Drugs: Classification of drugs based on structure and action: Antibacterial: sulfa drugs, synthesis of sulfathiazole, sulfapyridine, Antibiotics: β-Lactam antibiotics and synthesis of penicillin, chloramphenicol, Antiviral drugs: Azidothimidine, acyclovir; Antipyretics: Paracetamol, Analgesics: Analgine, Non-steroidal anti-inflammatory drugs: Ibuprofen, Antimalarial: Chloroquine, Antacids: Ranitidine

Engineering Materials: Energy materials, soft materials, smart materials, organic electronics, semiconductors, insulators, corrosion inhibitors

Introduction to Green Chemistry: Principles of green chemistry (12 principles), Green reagents (water and bio-based), solvents (green solvents eg. Water), and alternative reaction media (ionic liquids), multicomponent reactions, atom economy (examples: Diels-Alder reaction, Claisen rearrangement), sustainable organic chemistry

Food Chemistry: **Flavouring agents:** Definition of flavours–Classification–Chemical composition–common characteristics–Formulations–Uses and hazards, Preserving agents, antioxidants.

Sugar industry: Double sulphitation process. Refining and grading of sugar. Saccharin: synthesis and use as a sugar substitute – aspartame (structure and synthesis). Ethanol: manufacture from molasses by fermentation.

Learning Resources:

Text Books:

1. G. R. Chatwal, Gurudeep, Synthetic Organic Chemistry, Himalaya Publishers, 2009.
2. Ashutoshkar, Medicinal Chemistry, New Age Publications, 2010, Fifth Edition.
3. V. K. Ahluwalia, M. Kidwai, New Trends in Green Chemistry, New Age Publications, 2004
4. B. Srilakshmi , Food Science, New age International Pvt. Ltd. Publishers, III ed. 2003.

Reference Books:

1. John W. Nicholson, Chemistry and Physics of Modern Materials, Royal Society of Chemistry, 2012, Third Edition.
2. A. S. Khanna, High-Performance Organic Coatings, Elsevier, 2008
3. P.T. Anastas and J.C. Warner, Green Chemistry: Theory and Practice, Oxford University Press, 2000.
4. H.D. Belitz, Werner Grosch, Peter Schieberle, Food Chemistry, Springer Science & Business Media, 2009, Fourth Edition.

CY3326 **3-0-0 (3)**

Environmental Chemistry

Pre-Requisites: **None**

Course Outcomes:

CO-1	Identify relationship between chemical exposure and effects on physiological systems.
CO-2	Understand causes and effects of environmental pollution and mitigation strategies.
CO-3	Apply basic chemical concepts to analyze chemical processes involved in different environmental problems (air, water & soil).
CO-4	Describe water purification and waste treatment processes and the practical chemistry involved.
CO-5	Discuss local and global environmental issues based on the knowledge gained throughout the course.

Course Articulation Matrix:

	PO-1	PO-2	PO-3	PO-4	PO-5	PO-6	PO-7	PO-8	PO-9	PO-10	PO-11	PO-12	PSO-1	PSO-2	PSO-3	PSO-4
CO-1	3	2	2	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-2	3	2	2	2	2	2	–	–	–	–	–	–	–	–	–	–
CO-3	3	2	2	1	2	1	–	–	–	–	–	–	–	–	–	–
CO-4	3	3	3	2	1	2	–	–	–	–	–	–	–	–	–	–
CO-5	3	2	2	1	2	3	–	–	–	–	–	–	–	–	–	–

1 - Slightly; **2 - Moderately;** **3 - Substantially**

Syllabus:

Chemistry of Atmosphere: Origin, composition and structure of atmosphere-particles, ions and radicals in the atmosphere, Greenhouse effect-Causes, consequences and abatement of Greenhouse effect-Ozone depletion- Causes, consequences and abatement of ozone depletion, Photochemical smog-Effects and control.

Air Pollution-Monitoring and Control: Air sampling techniques-Sources and effects, of oxidesof sulphur, oxides of nitrogen, oxides of carbon, Monitoring of air pollutants by Instrumental methods, Monitoring and Control of particulate pollution- Monitoring of air pollutants by Instrumental methods, Control of air pollution by raw material change, process modification, adsorption, absorption and combustion methods.

Water Pollutants and waste water treatment: Water and Environment; Types of Pollutants, Pollution indicators, Waste water Constituents, water Quality requirements, various methods of waste water treatment.

Soil chemistry: Nature and composition of soil, Acid base and ion exchange reactions in soil, macronutrients in soil, Micronutrients in soil, Nitrogen, phosphorous and potassium in soil, Fertilizers, wastes and pollutants in soil, Soil loss and degradation, Agriculture and health.

Solid Waste Management and environmental impact assessment: Solid waste disposal and management: classification and origin, methods of solid waste disposal, Microbiology involved in solid waste disposal, Environmental Impact Assessment, Environmental Impact Assessment process in India-Environmental acts and rules.

Learning Resources:

Text Books:

1. G. S. Sodhi, Fundamental Concepts of Environmental Chemistry, Narosa publishing House, 2005, Second Edition.
2. M. N. Rao, A.K. Datta, Waste water treatment, Oxford Publications, 2013, Third Edition.

Reference Books:

1. J. Glynn Henry, Garry W. Heinke, Environmental Science and Engineering, Prentice-Hall, Inc., New Jersey, USA, 1996, Second Edition.

Semester – VII

ED3401 **3-1-0 (4)**

Perspectives on School Leadership & Management

Course Outcomes:

CO-1	Describe the diversity of schools in India, its structure, its governance, issues, challenges and school leadership needs.
CO-2	Critically examine the different leadership theories and practices and its relationship with the governance structures, the autonomy and accountability mechanisms and the larger educational policy context.
CO-3	Critically think in relation to education leadership and its potential application to different contexts.
CO-4	Reflect critically on school-based data for reflection and improvement.
CO-5	Develop a culture of cooperation collaboration and teamwork.
CO-6	Synthesise effectively to develop coherent and compelling arguments in the area of study.
CO-7	Develop school vision, mission, goals, and School Development Plans.

Syllabus:

Understanding Indian School System: School as a normative organization vis-a-vis school as a socio-emotional-cultural space for learning. Studying the diversity of schools in India; their structure, governance, socio-political and cultural context, funding, management, autonomy and accountability mechanisms, support systems. Relationship between school leadership and school diversity issues, challenges, and needs. Engagement with diversity discourses, educational policies, reforms and practices and role in developing inclusive schools.

Understanding School Leadership: School Leadership: concept as defined, and concept as practiced. Being a School Leader: exploring the multiple roles and responsibilities, issues andchallenges of school leadership in the Indian context. What works in schools: sharing National and International best practices on Schoolleadership.

Schools as Learning Organizations: Role of School Leadership: Schools as motivating learning spaces: Developing inspiring school ethos. Schools as learning organization: promoting personal mastery, examining mental models, and developing a shared vision, team learning and a system's thinking perspective. Development of a shared vision and shaping of the school culture. Use of data for school improvement focused on students' learning, addressing equitychallenges, and building an equitable school culture that promotes excellence for all. Nurturing school belongingness: engaging students, teachers, staff, parents, SMC, andcommunity in the formulation of a whole school development plan. Designing professional and collaborative learning opportunities for self and others(teachers, parents, and SMC members) and improving teaching and learning.

Suggestive Reading Materials:

1. Mathew A, Perspectives on school leadership and management,
2. Bush Tony and Les Bell, The Principles and Practice of Educational Management, Paul Chapman Publishing, 2002.
3. Ministry of Education, An Organizational history, National Institute of Educational Planning and Administration, 1990..

ED3403 **3-1-0 (4)**

Curriculum Planning & Development

Course Outcomes:

CO-1	Discuss aims of education,
CO-2	Identify and formulate of desirable values and dispositions,
CO-3	Explain capacities and knowledge,
CO-4	Outline curricular areas,
CO-5	Demonstrate teaching-learning assessment processes and
CO-6	Practice the relevance in terms of achieving the aims of school education

Syllabus:

Education and Curriculum: Meaning, need, relationship and significance, Types of Curriculums: subject-centered, activity-centered, environmental centered, community-centered. Relationship and difference between curriculum, curriculum framework, syllabus and textbooks.

Developing the Curriculum: Basic principles of Curriculum Development, concerns for developing the Curriculum - aims to be achieved, structure and nature of discipline, different perspectives on learning and their implications to curriculum development, socio–cultural aspects and aspirations of society, value transitions, social efficiency and needs, environmental concerns, gender concerns, inclusiveness, technological advancement. Impact of Globalization.

Approaches, Planning, and Implementation: Approaches to Curriculum Development: Learner and activity centred, Constructivist, Knowledge Construction Curriculum planning as a cyclic process, Curriculum Implementation: Operationalizing curriculum into learning situations, Converting curriculum into syllabus, Curriculum engagement activities, Role of school at Regional, State and National level for implementation, Role of teachers in operationalizing and evaluating the curriculum with special reference to: textbooks and teachers handbooks, source books, workbooks and manuals, other learning material such as kits, AV and software materials, library, laboratory, playground, neighborhood etc.

Suggestive Practicum

1. Arranging discussion on:
    - Basis of National curriculum frame works (1975, 1988, 2000, and 2005).
    - Document: Learning without burden" by Prof. Yashpal
2. Preparing of Report based on observation of:
    - Facilities and infrastructure to implement the present curriculum.
3. Interviewing teachers to understand their role in:
    - Implementing and assessment of the curriculum.
4. Analysis of the following in the context of principles of developing the Curriculum:
    - Guidelines of NEP, 2020.
    - Curriculum of 4 Years B.Ed. Integrated Programme
    - Learning without Burden, MHRD, and India.
    - Position paper (2006). National Focus Group on 'Curriculum, Syllabus, Textbooks', NCERT.

- NCERT (1988) National Curriculum for Elementary and Secondary Education: A framework.
- NCERT (2000) National Curriculum Framework for school Education.
- NCERT (2005) National Curriculum Framework. NCERT publications.

ED3105 **1-0-2 (2)**

Art Education
(Performing and Visual)

Course Outcomes:

CO-1	Articulate the importance of aesthetics and art in elementary education.
CO-2	Demonstrate their familiarity with and appreciation of puppetry.
CO-3	Design puppets.
CO-4	Practice and create a short puppetry show.

Syllabus:

Performing the puppets: This unit will engage in performance of puppetry and the level of communication skills required to create a good engaging story and perform it with the help of puppets they have created. The performance will be expected to relate to some activity in the educational context. Students will perform the puppets they have designed. Initially each member will play their own puppets. Later they will play in pairs, later they will be formed into a small group and asked to prepare their own skits with the puppets. They conclude by performing in small groups. Their learning isconsolidated and reflected.

Discussion is held on how different aspects of puppet making can be incorporated in class room processes of young children. Adapting the individual and group exercises done during the puppetry course will be discussed to be used in the classroom situation.

Suggestive Reading Materials:

1. David Currel, An introduction to puppets and puppet making, Book sales, 2019.
2. E. Francis Saunders, Puppets in schools, read Books, 2009.
3. Manu Sharma, Effect of Puppets Integrated Education on Creative Thinking Skills, LAP Lambert, 2020..

ED3407 **3-1-0 (4)**

Sports, Nutrition & Fitness

Course Outcomes:

CO-1	Explain the importance of sports, and the need and impact of sport for maintaining.
CO-2	Discuss physical fitness, and the methods of teaching and organization of different types of sports.
CO-3	Explain the importance of physical fitness, describe different components of physical fitness, and identify activities that help maintain physical fitness.
CO-4	Recognize the importance of basic health and nutrition and healthy lifestyles and identify food items that help maintain basic health and nutrition among children of different age groups.

Syllabus:

Sports: Meaning of sports, importance of sports, types of sports. Different stages of sports (primary and secondary). Psychology of sports, methods of teaching different sports (indoor, outdoor, team and individual), different sports activities (individual and team games). Sports for children with disabilities and inclusion.

Physical Fitness: Meaning and importance of Physical fitness, components of physical fitness, Muscular Strength, Endurance, Flexibility, Body Composition, Cardiovascular Endurance, importance of healthy lifestyle. Coordination of Health and Fitness.

Nutrition: Meaning of nutrition, types of nutrition, importance of nutrition, need of nutrition, methods for teaching nutrition, Nutrition for different age group, nutritious food for sports personalities and common individuals, nutrition and health, nutrition and fitness, nutritious food in schools(midday meals), hostels.

Suggestive Reading Materials:

1. John E Mixton & Ann E Jewett, An Introduction to Physical Education, W. B. Saunders Company, London,
2. Deborah A West & Charles A Bucher, Foundation of Physical Education – Exercise Science and Sports, Tata McGraw Hill, New Delhi,
3. NCERT (2013), Training and resource materials on Adolescence Education,
4. K. Park, Preventive and Social Medicine, Banarsidas Bhanot Publishers, Jabalpur,
5. Hema Singh, Become your own Nutritionist, Nation Press, 2021..

ED3409 **3-1-0 (4)**

School-Based Research Projects

Course Outcomes:

CO-1	Present contextual problems, an appropriate research design and the plan of action for undertaking school-based research,
CO-2	demonstrate the tools and techniques used for the collection of relevant data,
CO-3	summarize the analyzed data used to identify the causes,
CO-4	demonstrate the interventions used for addressing the problems,
CO-5	present the effectiveness of the intervention(s),
CO-6	share the school-based research experiences through reports and presentation.

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Syllabus:

The student teachers during previous semesters have studied different courses in Foundations of Education, Disciplinary Courses, Stage-specific pedagogy courses, Ability Enhancement and Value-Added Courses. The required knowledge of action research and case study includes- the concept and importance of action research/case study, the steps of conducting action research/case study (objectives, methods, research design, design tools, data collection, and data analysis) and report writing.

The research problem will be taken from the day-to-day teaching-learning process of the school. Some of the significant areas may cover:

- Learning progress and outcomes in different subjects
- School-based assessment
- Learners' diversity and inclusion
- Participation in arts, games, sports

Suggestive Mode of Transaction

The following strategies will be used during the school-based research project:

- Discussions with teacher educator, school head, mentors, and peers for identification of problem and development of intervention(s).
- Finalize the school-based research project proposal outline through discussion with mentor teachers/teacher educators.
- Document analysis, interaction with all stakeholders, and field visits.
- Sharing and presentation of the outcomes of school-based research.

ED3411 **3-1-0 (4)**

Internship in Teaching

Course Outcomes:

CO-1	explain the overall functioning of the school.
CO-2	describe and appreciate the different roles played by a teacher in the school.
CO-3	experience the importance of teacher-student relationships for effective teaching.
CO-4	develop age-appropriate pedagogic skills.
CO-5	use different pedagogies learnt in real-life classrooms.
CO-6	create appropriate teaching-learning materials.
CO-7	develop necessary planning and execution skills to conduct school activities (assembly, celebrations, cultural programmes).
CO-8	express the school, teacher, parents, and community relationships.
CO-9	create rapport with the stakeholders and understand their roles in the school system.
CO-10	create student portfolios and comprehensive 360-degree (holistic) progress reports.
CO-11	discuss the importance of maintaining different types of records in the school system.
CO-12	develop research aptitude and ability to conduct action research for the situations/problems faced during their school internship experience.

Syllabus:

1. Pedagogies' different methods and strategies
2. Scheme of lessons
3. Peer lesson observation
4. Management of substitute classes
5. Various TLMs (including ICT tools) and their uses in teaching-learning.
6. Achievement test
7. Diagnostic tests
8. Analysis of the result of the achievement test
9. Assembly activities
10. Action research and case studies.

Activities:

Student teachers are required to undertake the following stage specific activities:

1. Meet the subject-based mentors, collect timetables of classes IX to XII and develop a scheme of lessons from the syllabus to be covered during the internship.
2. Get acquainted with the school within 2-3 days. Observe classroom teaching of school teachers.
3. Plan and transact minimum 80 lessons (40+40), including 4 stray lessons (2+2). Stray lessons are class appropriate lessons on any topic(s) to be transacted by student teachers as per their convenience to build up confidence gradually. The last 5 lessons in each pedagogy course may be transacted using lesson notes.
    - Lesson plans should include the components to develop critical and reflective thinking, problem-solving, differential learning, synthesis, and application of knowledge in real-life situations.
    - Lesson plans must promote education for sustainability, including equity, environment, global citizenship, pride and rootedness in Indian knowledge systems and character building.

4. Participate in post-lesson discussions with peers, mentor(s) and teacher educators.
5. Observe peer lessons and discuss with the group.
6. Conduct laboratory activities (Atal Tinkering Lab, Physics, Chemistry, Biology, Mathematics, Languages, Social Science, Computer), sports, and arts and crafts activities.
7. Participate in student support services- guidance and counselling, NCC, NSS, health and wellness programme.
8. Create teaching-learning materials, including ICT tools for opted pedagogic courses.
9. Plan assessment, prepare material and formative and summative assessment tools, and analyze the results.
10. Prepare and conduct diagnostic tests to identify learning difficulties, analyze data and prepare learning enhancement plan.
11. Experience classes as a substitute teacher.
12. Participate in library functioning and literary activities.
13. Participate in teacher development and training activities.
14. Organize school assemblies and other events (cultural, sports, yoga, and other development activities).
15. Attend Parents-Teachers Association (PTA) meetings if held during the internship.
16. Attend School Management Committee (SMC) meeting if held during the internship.
17. Study the process of parent and community engagement for the school development programme.
18. Conduct action research /case study.
19. Prepare a sample student portfolio,
20. Write a reflective diary daily and prepare a report of each activity.

Semester – VIII

ED3402 **3-1-0(4)**

Philosophical & Sociological Perspectives of Education-II

Course Outcomes:

CO-1	Recognize the social context of education.
CO-2	Outline the meaning, nature, and scope of educational sociology.
CO-3	Establish the link between education and socialization.
CO-4	Analyze the main agents of socialization, such as family, school, community and peergroups.
CO-5	Analyze the impact of culture on education through a study of dimensions of culture andtheir importance to education practices.
CO-6	Recognize the different aspects of social stratification.
CO-7	Identify the close relationship between education and modernization, the role of education in Modernization, and factors and constraints to social change.

Syllabus:

Education and Society: Conceptual clarity, relationship, significance and aims of studying the relationship betweenthese two. Educational sociology and social perspective of education: meaning and functions. Education as a Social System. Conceptual clarity of the following terms: society, social behavior, status, institution, ideology, system, sub-system, socialization, social system, social values and norms, conflict, modernization. Understanding the relation between individual and group behavior with special reference to purpose of education.

Education and Social Change: Meaning, relation, and dimensions of Social Change. Factors affecting Education and Social Change: technology, social and educationalmovements, curricular innovations, value conflict, legal provisions. Constitution of India and Education. Education and Modernity. Role of education with reference to social change.

Education, Culture and Socialization: Relationship between Education and Culture. Education as a process of Socialization. Impact of following on Culture and Educational Process: Social Welfare, Social Reform Movements, Legal interventions on Child Marriage and child labor Act, Educational Policies and Acts, Adult Literacy, New Technology of communication, Equality. Constitutional Provisions and Education with special reference to Social Equality and Equity.

Education and Values: Conceptual Clarity, Relationship and Significance. Types of Values. Constitutional Values and its impact on our Education. Human Rights and Values. Environment and Education. Pedagogical issues.

Suggestive Reading Materials:

1. S. Samuel Ravi, Philosophical and Sociological bases of education, PHI, First Edition,
2. R. Pathak, Philosophical and Sociological perspectives of Education, Atlantic, 2023..

ED3404 **2-0-0(2)**

Education Policy Analysis

Course Outcomes:

CO-1	Discuss knowledge and capacity to engage in education policy analysis and evaluate their effectiveness.
CO-2	Explain processes involved in policy analysis including undertaking situation analysis and research. • To identify possible policy options, • Describing these possible options, • Comparing the potential policy options, • Ranking the possible policy options and • Choosing the most effective option that could address issues and problems confronting school education.

Syllabus:

Planning an Educational Policy: Meaning and significance of `Policy on Education'. Purpose and Dimensions of an Educational Policy at local and Global level. Philosophical and Sociological Perspective of planning an Educational Policy. Historical development of Educational Policies in India. Basic steps involved in planning. Constitutional provision for Policy on Education. Fundamental principles for analyzing an Educational Policy.

Educational Policies in India: Critical analysis of Policies on Education since Independence: 1968, 1986 (Modified in 1992), 2020 in the context of: need and significance, goals and frameworks of educational policies, content of policies, issues raised in policies, constitutional provisions, special stress, modification of policies, implementation strategies. Issue of modifying an Educational Policy.

Implementation of an Educational Policy: Meaning, need and significance. Mechanism of Policy Implementation. Strategies to Implement an Educational Policy. Programme of action and implementation: conceptual clarification and significance. Role of different Organization / Groups: Legislature/ Judiciary/ Political Will and Parties/Voluntary Organizations/ Non-governmental organizations (NGOs)/ Pressure Groups/Public. Challenges for Implementation.

Suggestive Reading Materials:

1. Akalank Kumar Jain & Riddhiman Jain, Handbook on National Educational Policy, 2020, Akalank Publication, 2023.
2. Dr. Joseph K Thomas, India's New Educational Policy 2020, The Write Order Publication, 2024.

ED3408 **1-0-2(2)**

Yoga & Understanding Self

Course Outcomes:

CO-1	Explain the importance of Yoga and how it helps an individual in understanding Self.
CO-2	Describe the importance of practicing Yoga Asana.
CO-3	Practice basic Yoga Asanas/ Kriyas.

Syllabus:

Philosophy and Historical Perspective of Yoga : Concept and Meaning of Yoga, Philosophy of Yoga, Brief history and development of Yoga (Classical Yoga, Post Classical Yoga and Modern Period) Importance of Yoga for healthy living, Yoga and its relevance in the modern times,Traditions in Yoga.

Schools of Yoga: Different streams \schools of Yoga (Gnana, Bhakthi, Karma). Construction of Yoga Practice for all round development. Principals of Yoga: - Ahimsa, Satya, Asteya, Brachmacharya, Aparigraha, Shoucha,Santhosha, Tapas, swadyaya and Isvara Paridhana.

Modern Principles of Yoga and Meditation: Modern Principles: Human Body is a holistic entity, Individuals and their need areDhāraṇa & Dhyāna, etc, meditation and reflective practices, and the importance of these aspects in becoming an effective teacher, unique Self-empowering, the quality and state of an individual mind is crucial to healing. Meditation: - its Importance, Types, and Process, Pranayama: its importance, types and process, Yoga as a Way of life for Peace, Harmony, Health love and happiness. Yoga in Indian philosophy for understanding Self.

Suggestive Reading Materials:

1. NCERT (2015): Yoga: A Healthy Way of Living Secondary Stage, New Delhi.
2. MDNIY (2010), Yoga Teachers Manual for School Teachers, New Delhi.
3. Morarji Desai, Yogasan, National Institute of Yoga, New Delhi.
4. Swami Satyanand Saraswathi, Asana Pranayama Mudra Bandh, Bihar School Yoga, Munger.
5. M. M. Ghore, Anotomy and Physiology of Yogic Practices, Lonavala Yoga Institute, Lonavala.

ED3410 **2-0-0(2)**

Citizenship Education, Sustainability, and Environment Education

Course Outcomes:

CO-1	Explain the concept of citizenship and citizenship education.
CO-2	Describe the aims of and approaches to citizenship education.
CO-3	Explain the concept and aims of Global Citizenship and Global Citizenship Education.
CO-4	Describe the aims of and approaches to global citizenship education.
CO-5	Explain the concept of 'Sustainability' in all fields of human activities, and approaches to achieving sustainable development in its three dimensions – economic, social and environmental – in a balanced manner.
CO-6	Demonstrate an awareness of environmental issues, and actions required for mitigating the effects of climate change, environmental degradation and pollution, and initiatives required for effective waste management, conservation of biological diversity, management of biological/natural resources, forest and wildlife conservation, and sustainable development and living.

Syllabus:

Citizenship Education: Concept of citizenship and citizenship education. Aims of and approaches to citizenship education. Concept of Global Citizenship and Global Citizenship Education. Aims of and approaches to global citizenship education. Concept of *Vasudhaiva Kutumbakam*, its importance in development of a holistic perspective towards local and global communities.

Sustainability: Concept of 'Sustainability' in all fields of human activities. Approaches to achieving sustainable development in its three dimensions – economic, social,and environmental. Sustainable development goals. Sustainable management of natural resources. School- and community-based activities. Education for sustainable development.

Environmental Education: Environmental issues. Actions required for mitigating the effects of climate change, reducing environmental degradation, pollution etc. Initiatives required for effective waste management, conservation of biological diversity,management of biological/natural resources, forest and wildlife conservation, and sustainable development and living. Approaches to delivering Environmental Education Role of Mass Media and Technology in delivering environmental education. Roles Governmental and Non-Governmental Organizations in promoting Environmental Education. School and community-based environmental education activities.

Suggestive Reading Materials:

1. RomilaThapar et al., On citizenship, Aleph Book Company, 2021.
2. Paul Jones, David Selby & Stephen Sterling, Sustainability Education, Routledge, 2010.
3. G. Lokanadha Reddy, Text book of Environmental Education, Discovery Publishing House, 2015.
4. Priyanka chopra, A Premier on Environmental Education, Anu Books, 2021.

ED3412 **2-0-0(2)**

Post Internship

Course Outcomes:

CO-1	demonstrate/Exhibit/Manifest comprehensive understanding of the school ecosystem,
CO-2	reflect on school internship experiences in a report.,
CO-3	share their learning from school internship with peers and teacher educators.

Syllabus:

After successful completion of internship programme in 7th semester, student teachers compile the learnings, discuss with peers about their experiences, reflect on the experiences, refine the artifacts developed during internship and prepare comprehensive internship report during post internship in 8th semester.

Activities:

1. **Experience Sharing and Reflective Learning**
    - Presentation of reflective journal summary
    - My Learning Journey: by each student-teacher
    - Gallery walks (Exhibition): TLMs, display of participation in school activities (photos/stories) and other artefacts created during the internship by student teachers.
    - Sharing of best practices (PPTs, Videos.)
    - Survey and collect the local stories and rhymes from the parents and community (in the context of the foundational stage)
    - Holding a training workshop for the parents and community and encouraging them to act as volunteers.
    - Awareness and advocacy programme in FLN for parents and community: Role play with parents and community on conducting specific FLN activities.
    - Organizing a parents /community mela/fair on homemade TLM for FS children
2. **Submission of Internship Report**
    - Reflective Journal
    - Lesson Plans and TLMs
    - Observation records (Teacher Educator, Mentor, school heads, Teachers, Parents)
    - Assessment records and Student Portfolio
    - Action research report/case study
    - Comprehensive internship report.

ED3414 **2-0-0(2)**

Creating Teaching Learning Material

Course Outcomes:

CO-1	demonstrate the use of TLM for enhanced learning,
CO-2	explain the importance of work experience and competencies of local crafts person.

Syllabus:

Having developed an understanding of education's philosophical, sociological, and psychological perspectives and gained hands-on experiences from pre-internship school observation and internship phases, the student teachers have developed a comprehensive understanding of education. By utilizing these experiences and understanding, the Student teachers will be in a position to develop/create Teaching Learning Materials (in various forms, Programed Learning Materials, Educational videos, teachers' handbooks, flashcards, story books, toys, games, posters, collages, innovative lesson plans using different pedagogies, to mention a few) which in turn may be helpful to both the school students with whom he/she has interacted during school experiences and the student teachers. Schools provide a systematic teaching environment for the learners to acquire the knowledge, skills and attitude required to meet the varied aspirational needs and educational goals. Work experience fosters basic knowledge, skills and disposition among the students that prepare them to think of becoming skilled entrepreneurs. To orient the school students on work education, the student teachers need exposure to visit the local vocational artisans, crafts person and entrepreneurs and prepare learning resources to enhance their professional skills and competencies. Teaching Learning Materials of good quality with (i) innovations, (ii) the use of low-cost materials, (iii) local context and (iv) modern technology (for digital learning materials) will enhance students' engagement, interest, and practical learning.

- Understanding how students learn at different stages.
- Knowledge of toys and other TLMs from different parts of the countries
- Knowledge of relevant TLMs for specific groups of children- CWSN, kinesthetic learners, visual learners, auditory learners addressing individual differences.

Activities to be conducted.

The following are a few suggestive activities:

- Orientation workshop on work experience and development of learning resources
- Field visit for interaction with local artisans, craftspeople, and entrepreneurs.
- Observe Traditional work practices and their integration into Local Technologies and Ideas.
- Analysis of available local specific, indigenous learning resources, including toys and their use in the learning-teaching process
- Development of at least two low-cost learning resources as per the local contexts (foundational/preparatory/middle/secondary) and presentation/exhibition
- Prepare the manual of TLM highlighting the objectives that will be achieved by its use, the material used, the process of its development and its use during classroom transaction.

Assessment

Competence/Artifact	Method of assessment	Assessed By	Credits
TLM developed	Presentation/Exhibition	Teacher Educators (panel of three experts including an external expert)	1.5
Manual	Presentation	Teacher Educator	0.5

ED3416 **2-0-0(2)**

Community Engagement and Service

Course Outcomes:

CO-1	recognize the socio-economic issues in the community and identify initiatives that could help solve problems faced by the community,
CO-2	demonstrate an awareness of the functions of the community, and the measures required for enlisting community participation in school-related activities,
CO-3	undertake initiatives that are required to make the community aware of the importance of education, issues associated with schooling, gender inequity, health & wellness of children, illiteracy among youth and adults in the community etc.,
CO-4	suggest actions in collaboration with community members to address the social, cultural and educational problems in the community,
CO-5	organize activities such as street plays, advocacy activities, door-to-door campaigns, and prabhat-pheris etc. to mobilize community participation in development initiatives,
CO-6	demonstrate social leadership quality through community services,
CO-7	organize interactions between schools and local communities for generating solutions to problems such as dropout and learning deficits,
CO-8	facilitate partnerships between local communities to enhance participation of the community in school-related activities such as PTA meetings,
CO-9	recognize the fault lines of the society, such as casteism, social taboos and superstitions etc. and work towards bridging them to establish harmony in the society,
CO-10	demonstrate positive feelings towards the local community and appreciate traditional knowledge and practices,
CO-11	Recognize the values of public service and active citizenship

Syllabus:

Approach to curriculum transaction

The student teachers will be provided opportunities to have exposure to community life for ten days in total, two days in Preparation for Community Engagement & Service in the institution, seven days working with the community, and the last day in the institution for sharing their experiences and reflections. The activities may be conducted in groups or individually as appropriate.

Days 1-2: Preparation for community services (In the institution)

- Orientation of student teachers on Community Engagement & Services through discussion and group activities.
- Workshop for developing tools for different activities during the programme.

Days 3-9: Engagement with the community (Mandatory onsite stay with the community)

Students will be divided into smaller groups; They would participate in the planned activities with defined roles for seven days on a rotation basis. These activities include:

- participation of student teachers in activities undertaken under the National Service Scheme (NSS), New India Literacy Programme, Student mentoring initiatives, etc.
- Survey of community resources for supporting school activities.
- Study of the situation regarding school dropout and the reason thereof (Stage wise).

- Survey of specific settlement to assess the situation about non-literates in the settlement, including identification of 4-5 non-literate youth and adults who will be supported by student teachers to become literate,
- Training of local youth in First Aid and other relevant interventions,
- Assessment of the situation about Health and wellness of children in a locality,
- Creating awareness of the importance of sustainable development, and making the community members aware of the need to support initiatives to ensure environmental protection, creating awareness of rainwater harvesting, mentoring school students with learning deficits, guidance and counselling to school students etc.)
- Visit and interact with local artisans and craftsperson

The above activities typically will include working with the community, collecting data, playing local games, community awareness programmes like nukkad natak, rallies, organizing and participating in the cultural programmes with the community members etc.

The student teachers shall conduct different pre-scheduled activities throughout the day. Morning sessions will be used for activities with the community and data collection. The afternoon session will be devoted to data analysis and preparation of the report, and participation in games & sports activities. Evening session will involve cultural activities with community members.

Day 10: Feedback session and Reflection (: In the Institution)

- Sharing experiences and discussion on activities carried out.
- Presentation and submission of report on the activities carried out.
- Evaluation of the activities by collecting feedback on the effectiveness of the campaign from the mentor and the students.
- Reflection of experience (individual/group) of organizing community service

Assessment components and weightage

- Involvement and active participation in activities relating to Community Engagement and Service: (Assessment method: Observation by teacher educator, teacher and community members); Weightage: 75%; Assessed by the teacher educator, teacher and community members),
- Group Report & Reflections: Method of assessment: Presentation by student teachers); Weightage: 25% (Assessed by Teacher Educator)

Suggestive Links

- Ministry of Education (2021).Vidyanjali: Guidelines for Promoting Community and Voluntary Participation for Enhancing Quality School Education, Government of India. https://vidyanjali.education.gov.in/assets/pdf/Final_Guidelines_Vidyanjali_%20December.pdf
- RIE Bhubaneswar (2020). Handbook on Field Engagement in Pre-service Teacher Education, Bhubaneswar, Regional Institute of Education.

Education Electives

ED3422 **3-1-0(4)**

Education for Mental Health

Course Outcomes:

CO-1	To understand the nature and evolution of the discipline of mental health.
CO-2	To develop an informed perspective on the key concepts, issues and debates in the field.
CO-3	To identify and address mental health concerns and issues within the personal and social realm.
CO-4	To develop a personal reflective approach in building sensitivity towards mental health concerns within school and community settings.
CO-5	To build some basic guidance and counselling skills in student teachers

Syllabus:

UNIT-I : Mental Health: Historical and Contemporary Perspectives
History and Evolution of Mental Health, with special reference to the three forces of psychology, Key Debates and Issues in Mental Health, Mental Hygiene vs. Mental Health; Universalism vs. Cultural Relativism, Nomothetic and Idiographic approach, Statistical and Ideological Perspective, Notions of a Healthy Personality.

UNIT-II: Mental Health: A Life Span Perspective
Understanding issues of mental health at home, school and society, with reference to childhood, adolescence and young adulthood, Mental health concerns, Frustration, conflict, stress and anxiety: Sources and management. Conflict and Frustration: Sources and Management, Development of Life Skills and Building of Resilience

UNIT-III: Mental Health in Schools
School Based Issues and Concerns: Home-school continuity – discontinuity; diverse school contexts; mental health concerns of teachers, Guidance and Counselling, Concept, need and techniques, Notion of teacher as a counselor, Designing and evaluating mental health interventions and programmes

UNIT-IV: Social Issues in Mental Health
Media, technology and communication, Contemporary lifestyles and related issues, Negotiating stereotypes: Gender, caste, class, region, and religion, Gender roles and sexual orientations, Religion and Morality

Suggestive Reading Materials:

1. Bernard, H. W.Mental Hygiene for Classroom Teachers. New York: McGraw Hill, 1961
2. Patel, V. and Thara, R. (Ed),. Meeting the Mental Health Needs of Developing Countries. New Delhi: Sage Publications, 2003
3. Ranganathan, N. (Ed.), Education for Mental Health. New Delhi: Shipra, 2012
4. Nayar, U.S. (Ed.), Child and Adolescent Mental Health. New Delhi: Sage, 2012
5. Caroll, H. A., Mental Hygiene: The Dynamics of Adjustment. New York: Prentice Hall, 1952

ED3424 **3-1-0(4)**

GUIDENCE AND COUNCELLING

Course Outcomes:

CO-1	To develop an understanding of the concepts of guidance and counseling.
CO-2	To understand the types of guidance.
CO-3	To acquaint students with different testing devices and techniques of guidance.
CO-4	To develop and understanding of the role of teacher as counselor.
CO-5	To create an awareness of the working of guidance centres.

Syllabus:

Introduction
Meaning, Nature, Need of Guidance, Functions of Guidance.

Types of Guidance
Educational Guidance - meaning, need and importance, Vocational Guidance - meaning, need and importance, Personal Guidance - meaning, need and importance.

Guidance Services
Job Analysis - concept, need, Job Satisfaction-concept, factors affecting job satisfaction, Occupational Information - concept, need.

Guidance of the Differently - Abled Students - Gifted, Slow Learners, Learning Disabilities (Dyslexia, Dysgraphia, Dyscalculia) – Identification, Mainstreaming and providing support services to Differently - Abled Students.

Counseling - meaning, purpose, scope, Types of Counseling - Directive, Non-directive, Eclectic.

Process of Counseling (introduction, in - depth, communication, suggestion), Skills in Counseling (listening, questioning, responding), Role of the Counselor, Professional Ethics of a Counselor.

Tools of Guidance and Counseling.
Psychological tests - meaning, need, limitations, Testing - Intelligence, Aptitude, Attitude, Achievement, Interest, Personality,

Techniques of Guidance and Counseling
Interview - types, procedure, Case Study, Cumulative Record, Anecdotal Record, Diary, Questionnaire

Suggestive Reading Materials:

1. Aggarwal J. C.,Educational and Vocational Guidance and Counseling, 7th Edition, Doaba House; Delhi, 2004
2. Chauhan S.S. Principles and Techniques of Guidance.
3. Gibson Robert & Mitchell Marianne, Introduction to Guidance and Counseling, 6th Edition, Prentice Hall of India, New Delhi, 2005
4. Kochhar S.K.Educational and Vocational Guidance in Secondary Schools, Sterling Publishers, New Delhi, 1987
5. Milne Aileen, Teach Yourself Counseling, McGraw Hill companies, Chicago, 2003.
6. Sharma Ramnath and Sharma Rachana, Guidance and Counseling in India, Atlantic Publishers and Distributors, New Delhi, 2004.

ED3426 **3-1-0(4)**

ADOLESCENT EDUCATION

Course Outcomes:

CO-1	To **d**evelop knowledge and sensitivity on matters related to reproductive health, sex and sexuality and communicate effectively on these issues.
CO-2	To understand about physical, physiological, psychological, socio-cultural and interpersonal issues related to the processes of growing up.
CO-3	To inculcate a healthy attitude towards sex and sexuality, respect for the opposite gender and an understanding of responsible sexual behavior.
CO-4	To develop an understanding about the desired life skills.
CO-5	To build a perspective on the socio-legal and cultural issues related to sex and sexuality.
CO-6	To acquire skills to use certain techniques such as question box, role play, value clarification and case studies, for enacting Adolescence Education Programmes.

Syllabus:

Adolescence Education:
Introduction, Understanding of physiological, socio-emotional, cognitive and cultural aspects, Adolescence Education: Concept, Need and Relevance, Issues and Challenges during Adolescence, Role of Social Agencies in Adolescence Education, School, Family, Media, Community

Life Skills Education
Understanding the need, concept, and significance of Life Skills Education, Relationship between Life Skills and Adolescence Education, Detailed study of Core Life Skills,

Sexual and Reproductive Health
Understanding Sexual and Reproductive Health, Myths and Misconceptions, STIs and HIV/AIDS: Causes, Prevention, Cure and Skills of Coping

Empowering Student Teachers
Preparation of Teachers, Dealing with personal self constraints, Socio- cultural issues, Class room issues and challenges Pedagogical Approaches to Adolescence Education, Case studies and Critical Incidents, Brainstorming, Role-playing, Buzz groups, Gaming, Value clarifications, Question Box, Discussions and Debates, Puppet shows, Role Reversal, Walkabouts, Video shows.

Suggestive Reading Materials:

1. Agochiya, D., Life Competencies for Adolescents: Training Manual for Facilitators, Teachers and Parents. New Delhi: Sage, 2010
2. Archer, S.L.Interventions for Adolescent Identity Development. New Delhi: Sage, 1994
3. Atwater, E., Psychology for Living: Adjustment, Growth and Behaviour Today. (5thed.). New Jersey: Prentice Hall, 1994
4. Chowdhary, G.B., Adolescence Education. New Delhi: PHI, 2014
5. Dusek, J. B., Adolescent Development and Behaviour. New Jersey: Prentice Hall, 1991