Dr. Babasaheb Ambedkar Technological University, Lonere

(Established as a University of Technology in the State of Maharashtra)

(Under Maharashtra Act No. XXIX of 2014)

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Curriculum for First Year
Undergraduate Degree Programme
B. Tech. in Petrochemical Engineering

With effect from AY 2023-2024

Proposed Structure for Petrochemical Engineering as per NEP

	Course Code	Course Title	L	T	P	Cr	Categorisation
SEM- I		Engineering Physics	3	0	0	3	BSC
		Engineering Physics Lab	0	0	2	1	BSC
		Engineering Mathematics-I	3	1	0	4	BSC
		Programming for problem solving	2	0	0	2	ESC
		Programming for problem Solving Lab	0	0	2	1	ESC
		Engineering Graphics and Design	2	0	0	2	ESC
		Engineering Graphics and Design Lab	0	0	2	1	ESC
		Communication Skills	2	0	0	2	AEC/VEC/IKS
		Communication Skills Lab	0	0	2	1	AEC/VEC/IKS
		Design Thinking	2	0	0	2	VSEC
		A. NSS-I B. NCC C. Introduction to Yoga	1	0	2	2	CC
		Total	**15**	**1**	**10**	**21**	
SEM- II		Engineering Chemistry	3	0	0	3	BSC
		Engineering Chemistry Lab	0	0	2	1	BSC
		Engineering Mathematics-II	3	1	0	4	BSC
		Basic Electrical & Electronics Engineering	2	1	0	3	ESC
		Basic Electrical & Electronics Engineering Lab	0	0	2	1	ESC
		Engineering Mechanics	3	0	0	3	ESC
		Energy and Environment Engineering	1	0	0	1	ESC
		Energy and Environment Engineering Lab	0	0	2	1	ESC
		Introduction to Petrochemical Engineering	2	0	0	2	PCC
		Workshop-Manufacturing practices	0	0	4	2	VSEC
		IKS Bucket[#]	2	0	0	2	AEC/VEC/IKS
		A. NSS-II B. Health & Wellness C. Study from Still Life D. Hindustani Music	1	0	2	2	CC
		Total	**17**	**2**	**12**	**25**	

Exit option with: * Introduction to Petrochemical Engineering (Internship of 6 weeks in any one relevant field), *Course on Process Plant Safety,*Course on word processing, spread sheets and power point presentation.

Syllabus for Petrochemical Engineering (First year)

SEMESTER I

Engineering Physics	03 Credits

Course Objectives:
1. To provide a firm grounding in the basic physics principles and concept to resolve many Engineering and technological problems.
2. To understand and study the Physics principles behind the developments of engineering materials.

Course Outcomes:

Students will be able to:

CO1: Students acquired basic knowledge of differential equation and can create wave equation and analysis of the intensity variation of light due to interference and polarization. Students are able to understand the light propagation in fibre and use of Laser in Science and engineering.

CO2: Students can apply the knowledge of quantum mechanics to set Schrödinger's equations.

CO3: Students will familiar with some of the basic laws related to electromagnetism and Maxwell's equation as well as properties of dielectrics.

CO4: Students are able to understand key principle and application of nuclear physics. Identify planes in crystal and characteristics measurements of cubic system.

CO5: Students are able to explain fundamental concepts of magnetism and they should analyse the properties of semiconducting materials and describe various applications of superconductor.

Unit I:
Engineering Optics: Interference: in thin film due to reflected light, wedge shaped film, Newton' Rings, Applications, Polarization: types of polarization, optical activity, specific rotation and Laurentz half shade polarimeter, Lasers: characteristics, Gas Laser, solid state Laser and semiconductor lasers, Applications of Lasers, Optical fibres: Acceptance cone, Numerical aperture, applications, Oscillations: free oscillations, forced oscillations and damped oscillation, resonance and it's condition.

UNIT-II:
Quantum Mechanics: Wave and particle duality of radiation – de Broglie concept of matter waves – Wave function and its physical significance, Heisenberg's uncertainty principle and its application – Schrodinger's wave equation – Eigen values and Eigen functions, particle confined in one dimensional infinite square well potential, Introduction to quantum computing.

UNIT-III:
Electromagnetism: Differential and integral calculus: Operator, Concept of gradient, divergence and curl, Ampere's law, Faraday law, Gauss–Divergence theorem, integral and

differential forms of Maxwell equations and their physical significance, EM waves in free space. Dielectrics: polarization, Types of Dielectric polarization, dielectric constant, polar - non polar dielectrics.

UNIT-IV:

Crystal Structure: Fundamental concepts, Crystal systems Cubic structure: Number of atoms, co-ordination number, packing fraction, Atomic radius, Miller indices, relation between 'ρ' and 'a'. Nuclear Physics: Nuclear properties Introduction to mass defect & packing fraction, Nuclear reaction: Q value of Nuclear reaction,- Radioactivity – properties of α, β and γ rays, GM Counter

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UNIT-V:

Physics of Advanced Materials: Types of magnetic materials, ferrites and garnets, magnetic domain and hysteresis curve, Semiconductors, conductivity of semiconductors, Hall Effect Superconductors: definition – Meissner effect – type I & II superconductors, Nanomaterials: introduction and properties – synthesis: top-down and bottom-up approach, Introduction to SCADA, XRD, FESEM, VSM and applications.

Text books:
1. Introduction to Electrodynamics –David R. Griffiths.
2. Concept of Modern Physics – Arthur Beizer. Tata McGraw-Hill Publishing Company Limited.
3. Optics –Ajoy Ghatak. MacGraw Hill Education (India) Pvt. Ltd.
4. Science of Engineering Materials- C.M. Srivastava and C. Srinivasan. New Age International Pvt. Ltd.
5. Solid State Physics – A.J. Dekker. McMillan India –Limited.
6. The Feynman Lectures on Physics Vol I, II, III.
7. Introduction to Solid State Physics – Charles Kittel. John Willey and Sons
8. Engineering Physics – M.N. Avadhanulu and P.G. Kshirsagar.S.Chand and Company LTD.
9. Engineering Physics - R.K. Gaur andS. L. Gupta. Dhanpat Rai Publications Pvt. Ltd.- New Delhi.
10. Fundamental of Physics - Halliday and Resnik. Willey Eastern Limited.
11. Nanotechnology: An Introduction to Synthesis, Properties and Applications of Nanomaterials- Thomas Varghese , K. M. Balakrishna

Engineering Physics Laboratory   01 Credit

At least 08 experiments should be performed from the following list.

1. Newton's rings - Determination of radius of curvature of Plano convex lens / wavelength of light
2. Wedge Shaped film - Determination of thickness of thin wire
3. Half shade Polarimeter - Determination of specific rotation of optically active material
4. Laser - Determination of wavelength of He-Ne laser light
5. Magnetron Tube - Determination of 'e/m' of electron
6. G.M. Counter - Determination of operating voltage of G.M. tube
7. Crystal Plane – Study of planes with the help of models related Miller Indices
8. Hall Effect - Determination of Hall Coefficient
9. Four Probe Method - Determination of resistivity of semiconductor
10. Measurement of Band gap energy of Semiconductors
11. Experiment on fibre optics
12. B-H Curve Experiment
13. Experiments on SCADA

Engineering Mathematics –I   04 Credits

Course Objectives:
1. To know the application of the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem.
2. To know and apply the concept partial derivatives and their applications to Maxima/ Minima, series expansion of multi valued functions.
3. To understand Computation of Jacobian of functions of several variables and their applications to engineering problems.
4. To identify and sketch of curves in various coordinate system.
5. To evaluate multiple integrals and their applications to area and volume.

Course Outcomes:
Students will be able to:
CO1: Apply the matrix technique (Linear algebra) to find solutions of system of linear equations arising in many engineering problem.

CO2: Demonstrate the concept partial derivatives and their applications to Maxima/ Minima, series expansion of multi valued functions.

CO3: Compute Jacobian of functions of several variables and their applications to engineering problems.

CO4: Identify and sketch of curves in various coordinate system.

CO5: Evaluate multiple integrals and their applications to area and volume.

Unit I: Linear Algebra- Matrices

Inverse of a matrix by Gauss-Jordan method; Rank of a matrix; Normal form of a matrix ; Consistency of non- homogeneous and homogeneous system of linear equations ; Eigen values and eigen vectors ; Properties of eigen values and eigen vectors (without proofs); Cayley-Hamilton's theorem (without proof) and its applications.

Unit II: Partial Differentiation

Partial derivatives of first and higher orders; Homogeneous functions – Euler's Theorem for functions containing two and three variables (with proofs); Total derivatives; Change of variables.

Unit III: Applications of Partial differentiation

Jacobians-properties;Taylor"s and Maclaurin"s theorems (without proofs) for functions of two variables; Maxima and minima of functions of two variables; Lagrange"s method of undetermined multipliers.

Unit IV: Reduction Formulae and Tracing of Curves

Reduction formulae for $\int_0^{\frac{\pi}{2}} sin^n x \, dx$, $\int_0^{\frac{\pi}{2}} cos^n x \, dx$, $\int_0^{\frac{\pi}{2}} sin^m x \, cos^n x dx$, tracing of standard curves given in cartesian, parametric and polar forms.

Unit V: Multiple Integra

Double integration in Cartesian and polar co-ordinates; Evaluation of double integrals by changing the order of integration and changing to polar form; Triple integral; Applications of multiple integrals to find area as double integral , volume as triple integral and surface area.

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol I) by Dr. B. B. Singh, Synergy Knowledgeware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan,Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O" Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:
1. The tutorial classes in Engineering Mathematics-I are to be conducted batchwise.
2. Each class should be divided into three batches for the purpose.
3. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
4. The minimum number of assignments should be eight covering all topics.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Mathematics –I	Prof. Jitendra Kumar	IIT Kharagpur

Programming for Problem Solving	**02 Credits**

Course Objective:
To develop logical skills and basic technical skills so that students should be able to solve basic computing problems. The students should be able to learn the basic of any computer programming language.

Course Outcomes:
Students will be able to:
CO1: To formulate simple algorithms for arithmetic and logical problems.
CO2: To translate the algorithms to programs (in C language).
CO3: To test and execute the programs and correct syntax and logical errors.
CO4: To implement conditional branching, iteration and recursion.
CO4: To decompose a problem into functions and synthesize a complete program using divide and conquer approach.
CO5: To use arrays, pointers and structures to formulate algorithms and programs.
CO6: To apply programming to solve matrix addition and multiplication problems and searching and sorting problems.
CO7: To apply programming to solve simple numerical method problems, namely rot finding of function, differentiation of function and simple integration.

Detailed contents:
Unit I: Introduction to Programming
Introduction to components of a computer system (disks, memory, processor, where a program is stored and executed, operating system, compilers etc.). Idea of Algorithm: steps to solve logical and numerical problems. Representation of Algorithm: Flowchart/Pseudo code with examples. From algorithms to programs; source code, variables (with data types) variables and memory locations, Syntax and Logical Errors in compilation, object and executable code.

Unit II: Arithmetic expressions and precedence, Arrays
Conditional Branching and Loops Writing and evaluation of conditionals and consequent branching Iteration and loops, Arrays (1-D, 2-D), Character arrays and Strings

Unit III : Basic Algorithms

Searching, Basic Sorting Algorithms (Bubble, Insertion and Selection), Finding roots of equations, notion of order of complexity through example programs (no formal definition required)

Unit IV: Function and Recursion

Functions (including using built in libraries), Parameter passing in functions, call by value, passing arrays to functions: idea of call by reference.

Recursion, as a different way of solving problems. Example programs, such as Finding Factorial, Fibonacci series, Ackerman function etc. Quick sort or Merge sort.

Unit V: Structures and Pointers

Structures, Defining structures and Array of Structures.

Idea of pointers, Defining pointers, Use of Pointers in self-referential structures, notion of linked list (no implementation).

Text Books:

1. Byron Gottfried, Schaum's Outline of Programming with C, McGraw-Hill
2. E. Balaguruswamy, Programming in ANSI C, Tata McGraw-Hill.

Reference Book:

1. Brian W. Kernighan and Dennis M. Ritchie, The C Programming Language, Prentice Hall of India

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Problem Solving Through Programming In C	Prof. Anupam Basu	IIT Kharagpur

Programming for Problem Solving Lab	**01 Credit**

At least 08 experiments should be performed from the following list:

1. Familiarization with programming environment
2. Simple computational problems using arithmetic expressions
3. Problems involving if-then-else structures
4. Iterative problems e.g., sum of series
5. 1D Array manipulation
6. Matrix problems, String operations
7. Simple functions
8. Programming for solving Numerical methods problems
9. Recursive functions
10. Pointers and structures
11. File operations

Engineering Graphics & Design	02 Credits

Course Objectives:

1. To prepare you to design a system, component, or process to meet desired needs within realistic constraints such as economic, environmental, social, political, ethical, health and safety, manufacturability, and sustainability.
2. To prepare you to communicate effectively
3. To prepare you to use the techniques, skills, and modern engineering tools necessary for engineering practice

Course Outcomes:
Students will be able to:
CO1: Introduce the engineering design and its place in society
CO2: Expose to the visual aspects of engineering design
CO3: Expose to engineering graphics standards
CO4: Expose to solid modelling
CO5: Expose to computer-aided geometric design
CO6: Expose to creating working drawings
CO7: Expose to engineering communication

Unit I: Traditional Engineering Graphics:
Principles of Engineering Graphics; Orthographic Projection; Descriptive Geometry; Drawing Principles; Isometric Projection; Surface Development; Perspective; Reading a Drawing; Sectional Views; Dimensioning & Tolerances; True Length, Angle; intersection, Shortest Distance.

Unit II: Computer Graphics:
Engineering Graphics Software; -Spatial Transformations; Orthographic Projections; Model Viewing; Co-ordinate Systems; Multi-view Projection; Exploded Assembly; Model Viewing; Animation; Spatial Manipulation; Surface Modelling; Solid Modelling; Introduction to Building Information Modelling (BIM).

Unit III: Introduction to Engineering Drawing
Principles of Engineering Graphics and their significance, usage of Drawing instruments, lettering, Conic sections including the Rectangular Hyperbola (General method only); Cycloid, Epicycloid, Hypocycloid and Involute; Scales – Plain, Diagonal and Vernier Scales;

Unit IV: Projections
Orthographic Projections: Principles of Orthographic Projections-Conventions - Projections of Points and lines inclined to both planes; Projections of planes inclined Planes - Auxiliary Planes; Projections of Regular Solids: those inclined to both the Planes- Auxiliary Views; Draw simple annotation, dimensioning and scale. Floor plans that include: windows, doors, and fixtures such as WC, bath, sink, shower, etc.

Unit V: Sectioning of Solids, Isometric Projections

Sectioning of solids: Section planes perpendicular to one plane and parallel or inclined to other plane. Isometric projections: Isometric scale, drawing of isometric projections from given orthographic views.

Reference/Text Books:

1. N. D. Bhatt, Engineering Drawing, Charotar Publishing House, 46th Edition, 2003.
2. K. V. Nataraajan, A text book of Engineering Graphic, Dhanalakshmi Publishers, Chennai, 2006.
3. K. Venugopal and V. Prabhu Raja, Engineering Graphics, New Age International (P) Ltd, 2008.
4. Dhananjay A. Jolhe, Engineering Drawing with an Introduction to Autocad, Mc GrawHill Education, 2017.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Graphics and Design	Prof. Naresh Varma Datla, Prof. S. R. Kale	IIT Delhi

Engineering Graphics & Design Laboratory	**01 Credit**

List of Experiments

1. Lines, lettering and dimensioning.
2. Geometrical Constructions.
3. Orthographic projections.
4. Projections of points and straight lines
5. Projections of planes.
6. Projections of solids.
7. Section of solids.
8. Isometric Projections.

Communication Skills	02 Credits

Course Objectives:

1. To provide learning environment to practice listening, speaking, reading and writing skills.
2. To assist the students to carry on the tasks and activities through guided instructions and materials.
3. To effectively integrate English language learning with employability skills and training.
4. To provide hands-on experience through case-studies, mini-projects, group and individual presentations.

Course Outcome:

Students will be able to:

CO1: The student will acquire basic proficiency in English including reading and listening comprehension, writing and speaking skills.

Unit I: Vocabulary Building
1.1. The concept of Word Formation
1.2. Root words from foreign languages and their use in English
1.3. Acquaintance with prefixes and suffixes from foreign languages in English to form derivatives.
1.4. Synonyms, antonyms, and standard abbreviations.

Unit II: Basic Writing Skills
1.1. Sentence Structures
1.2. Use of phrases and clauses in sentences
1.3. Importance of proper punctuation
1.4. Creating coherence
1.5. Organizing principles of paragraphs in documents
1.6. Techniques for writing precisely

Unit III: Identifying Common Errors in Writing
1.1. Subject-verb agreement
1.2. Noun-pronoun agreement
1.3. Misplaced modifiers
1.4. Articles
1.5. Prepositions
1.6. Redundancies
1.7. Clichés

Unit IV: Nature and Style of sensible Writing
1.1. Describing
1.2. Defining
1.3. Classifying
1.4. Providing examples or evidence
1.5. Writing introduction and conclusion

Unit V: Writing Practices
1.1. Comprehension
1.2. Précis Writing
1.3. Essay Writing

Oral Communication

(This Module involves interactive practice sessions in Language Lab)
- Listening Comprehension
- Pronunciation, Intonation, Stress and Rhythm
- Common Everyday Situations: Conversations and Dialogues
- Communication at Workplace
- Interviews
- Formal Presentations

Text/Reference Books:
1. AICTE's Prescribed Textbook: English (with Lab Manual) ISBN: 978-93-91505-097
2. Effective Communication Skills. Kul Bhushan Kumar, Khanna Book Publishing, 2022.
3. Practical English Usage. Michael Swan. OUP. 1995.
4. Remedial English Grammar. F.T. Wood. Macmillan.2007
5. On Writing Well. William Zinsser. Harper Resource Book. 2001
6. Study Writing. Liz Hamp-Lyons and Ben Heasly. Cambridge University Press. 2006.
7. Communication Skills. Sanjay Kumar and PushpLata. Oxford University Press. 2011.
8. Exercises in Spoken English. Parts. I-III. CIEFL, Hyderabad. Oxford University Press.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	English Language for Competitive Exams	Prof. Aysha Iqbal	IIT Madras
2	Technical English for Engineers	Prof. Aysha Iqbal	IIT Madras

Communication Skill Lab	**01 Credit**

List of Practicals:

1. How to introduce oneself ? (02 hrs)
2. Know your friend (02 hrs)
3. Introduction to Phonemic symbols (02 hrs)
4. Articulation of sounds in English with proper manner (02 hrs)
5. Practice and exercises on articulation of sounds (02 hrs)
6. Read Pronunciations/transcriptions from the dictionary (02 hrs)
7. Practice and exercises on pronunciations of words (02 hrs)
8. Introduction to stress and intonation (02 hrs)
9. Rapid reading sessions (02 hrs)
10. Extempore (02 hrs)
11. Group discussion (02 hrs)
12. Participating in a debate (02 hrs)
13. Presentation techniques (02 hrs)
14. Interview techniques (02 hrs)

Design Thinking	02 Credits

Course Objective: The objective of this Course is to provide the new ways of creative thinking and Learn the innovation cycle of Design Thinking process for developing innovative products which useful for a student in preparing for an engineering career.

Course Outcomes (CO):
Students will be able to:
CO1: Compare and classify the various learning styles and memory techniques and apply them in their engineering education.
CO2: Analyze emotional experience and Inspect emotional expressions to better understand users while designing innovative products.
CO3: Develop new ways of creative thinking and learn the innovation cycle of Design Thinking process for developing innovative products.
CO4: Propose real-time innovative engineering product designs and Choose appropriate frameworks, strategies, techniques during prototype development.
CO5: Perceive individual differences and its impact on everyday decisions and further create a better customer experience.

COURSE CONTENTS:
Unit I: An Insight to Learning and Remembering Memory
Understanding the Learning Process, Kolb's Learning Styles, Assessing and Interpreting, Understanding the Memory process, Problems in retention, Memory enhancement techniques

Unit II: Emotions and Basics of Design Thinking
Understanding Emotions: Experience & Expression, Assessing Empathy, Application with Peers, Definition of Design Thinking, Need for Design Thinking, Objective of Design Thinking, Concepts & Brainstorming, Stages of Design Thinking Process (explain with examples) –Empathize, Define, Ideate, Prototype, Test.

Unit III: Problem Fixing and Process of Product Design
Understanding Creative thinking process, Understanding Problem Solving, Testing Creative Problem Solving, Process of Engineering Product Design, Design Thinking Approach, Stages of Product Design, Examples of best product designs and functions, Assignment – Engineering Product Design.

Unit IV: Prototyping & Testing
What is Prototype? Why Prototype? Rapid Prototype Development process, Testing, Sample Example, Test Group Marketing.

Unit V: Design Thinking & Customer Centricity
Practical Examples of Customer Challenges, Use of Design Thinking to Enhance Customer Experience, Parameters of Product experience, Alignment of Customer Expectations with Product Design.

Text books:

1. Karmic Design Thinking by Prof. Bala Ramadurai,

References:
1. Design: Creation of Artifacts in Society by Prof. Karl Ulrich, U. Penn
2. Change by Design by Tim Brown.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Understanding Design Thinking and People Centred Design	Prof. Jhumkee Iyengar	IIT Kanpur

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NSS-I	**02 Credits**

Course Objectives:

After completion of the course, students will have adequate background, conceptual clarity and knowledge of appropriate solution techniques related to :

1. Indian constitution, fundamental rights and duties of citizens
2. Health, hygiene and sanitation
3. Environmental issues and its management
4. Indian youth development in different aspects

Course Outcomes (CO):
Students will be able to:
CO1: Understand features of Indian constitution, fundamental rights and duties of citizens
CO2: Explain importance of Health, Hygiene & Sanitation
CO3: Summarize yoga a tool for healthy lifestyle
CO4: Conclude environmental issues and organize its management
CO5: Classify the disasters and youth role in its management

COURSE CONTENTS:
Unit I
Introduction and Basic Concepts of NSS: History, Philosophy, Aims and objectives of NSS Organizational structure, Concept of regular activities, Special camping, Day Camps. Basis of adoption villages/slums, Methodology of conducting survey

Unit II
Youth and Community Mobilization: Definition, Profile of youth, Categories of youth, Issues, Challenges and opportunities for youth, Youth as an agent of social change, Youth-adult partnership, Mapping of community stakeholders, Identifying methods of mobilization, Needs & importance of volunteerism**.**

Unit III
Importance and Role of Youth Leadership: Meaning and types of leadership, Qualities of good leaders; Traits of leadership, Importance and role of youth leadership.

Unit IV
Life Competencies and Skill: Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management.

Unit V
Social Harmony and National Integration: Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building
Youth Development Programs in India: National Youth Policy, Youth development programs at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations.

Introduction to Yoga	02 Credits

Course Objectives:
1. To learn Message of Vedas and Upanishads
2. To learn Four Streams of Yoga,
3. To learn Shaddarshanas or the SIX systems of Indian Philosophy,
4. To introduce with Hatha Yoga and Patanjali Yoga Sutras
5. To understand Life and message of spiritual masters and Indian Culture
6. To understand Anatomy and Physiology, Yoga and Exercise Physiology

Course Outcomes:
CO1: Students should be able to learn Message of Vedas And Upanishads
CO2: Students should be able to learn Four Streams of Yoga,
CO3: Students should be able to learn Shaddarshanas or the SIX systems of Indian Philosophy,
CO4: Students should be able to introduce with Hatha Yoga and Patanjali Yoga Sutras
CO5: Students should be able to understand Life and message of spiritual masters and Indian Culture
CO6: Students should be able to understand Anatomy and Physiology, Yoga and Exercise Physiology

COURSE CONTENTS:
Unit I:
Message of Vedas and Upanishads: Search for Happiness, Search for Reality

Unit II:
Streams of Yoga: Bhakti Yoga, Raja Yoga - Antaranga Yoga, Bahiranga Yoga, Karma Yoga -Secrets of Action, Jnana Yoga

Unit III
Shaddarshanas – Nyaya, Vaishesika, Sankhya, Uttaramimamsa, Purvamimamsa

Unit IV:
Life and Message of Spiritual Masters –Sri Ramakrishna Paramahamsa, Maa Sharada Devi, Swami Vivekananda, Indian Culture

Unit V:

Anatomy and Physiology, Yoga and Exercise Physiology, Yoga & Health - Concept of Health and Pancha Kosha Vivek, Yogic Concept of Health and Disease

Reference:

1. NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Introduction to Yoga and Applications of Yoga	Prof. Sridhar Melukote	Swami Vivekananda Yoga Anusandhana Samsthan

SEMESTER II

Engineering Chemistry   **03 Credits**

Course Objectives:
1. To impart the knowledge of chemistry in the area of Engineering and Technology.
2. To capable the student to explain the importance of chemistry in various fields of Engineering.
3. To identify the concept of chemistry to lay the ground work for subsequent studies.

Course Outcomes:
Students will be able to:

CO1: Students should be able to understand and explain the basic concepts of Water treatment and capable to explain softening processes and water Characteristics.

CO2: Students should be able to classify and explain various types of Corrosion and should apply methods to minimize the rate of Corrosion.

CO3: Students should be able to classify and explain various types of coals and lubricants, its physical and chemical properties and industrial importance.

CO4: Students should know the concept of Electrochemistry and its importance.

CO5: Student should be able to understand and explain various instrumental methods of Analysis.

Unit I: Water Treatment
Introduction, Hard and soft water, Disadvantages of hard water, Softening of water – Ion exchange process, Hot lime –soda process, Hardness and its determination by EDTA method, Dissolved oxygen (DO) and its determination by Winkler's method, Numerical based on hardness, Sewage water treatment.

Unit II: Corrosion and its Control
Introduction, Fundamental reason of corrosion, Electrochemical corrosion (Wet Corrosion), Mechanism of Wet corrosion, Direct Chemical corrosion (Dry corrosion), Factors affecting the rate of corrosion, Types of corrosion-Pitting corrosion, Microbiological corrosion, Methods to minimize the rate of corrosion- Proper designing, Cathodic and anodic protection method.

Unit III: Fuels and Lubricants
Fuels: Introduction, Classification of fuel, Calorific value of a fuel, Characteristics of a good fuel, Solid fuel- Coal and various types of coal, Analysis of coal- Proximate and Ultimate analysis, Liquid fuel- Refining of petroleum.

Lubricants: Introduction, classification of lubricants - Solid, Semi –solid and Liquid lubricants, Properties of lubricants: Physical properties – viscosity, viscosity index, surface tension, Flash point and Fire point. Chemical properties – acidity, saponification value.

Unit IV: Electrochemistry
Introduction, Electrical conductance, Conductance measurement by Wheatstone bridge method, Cell constant, Conductometric titrations, Glass electrode and its application for pH

measurement, Ostwald's theory of acid- base indicator, Rechargeable batteries i) Lithium ion battery, ii) Lithium battery, Fuel cell (H2-O2), Advantages of fuel cell.

Unit V: Instrumental Methods of Analysis
UV-Visible spectroscopy-Introduction, Laws of absorption -Beer's - Lambert's law, Instrumentation and working of double beam spectrophotometer.
Flame Photometry (Flame emission spectroscopy) - Introduction, Principle and working.
Chromatography- Introduction, Classification, Thin layer chromatography (TLC).
Brief discussion on IR spectroscopy.

Textbooks:
1. Jain P.C & Jain Monica, Engineering Chemistry, Dhanpat Rai& Sons, Delhi, 1992.
2. Bhal &Tuli, Text book of Physical Chemistry, S. Chand & Company, New Delhi.
3. Shikha Agarwal, Engineering Chemistry- Fundamentals and applications, Cambridge Publishers - 2015.
4. Gurudeep Chatwal and Sham Anand, Instrumental methods of Chemical Analysis, Himalaya Publishing House, New Delhi

Reference books:
1. Barrow G.M., Physical Chemistry, McGraw-Hill Publication, New Delhi.
2. O. G. Palanna , Engineering Chemistry, Tata McGraw-Hill Publication, New Delhi.
3. WILEY, Engineering Chemistry, Wiley India, New Delhi 2014.
4. S.S.Dara, Engineering Chemistry, McGraw Hill Publication, New Delhi.
5. Willard, Hobart H.; Merritt, Lynne L., Jr.; Dean, John A. Instrumental Methods of Analysis, American Chemical Society

Engineering Chemistry Lab	01 Credit

List of Experiments: (Perform any 9 – 10 Experiments)
1. Determination of Hardness of water sample by EDTA method.
2. Determination of Chloride content in water sample by precipitation titration method.
3. Determination of Dissolve Oxygen in water by Iodometric method.
4. Determination of Percent purity of Bleaching Powder.
5. pH – metric Titration (Acid Base titration)
6. Conductometric Titration (Acid Base titration)
7. Surface tension
8. Viscosity
9. To determine Acidity of water sample.
10. To determine Calorific value of a fuel.
11. Determination of Acid value of an oil sample.
12. Determination of Saponification value of an oil sample.
13. To verify Beer's-Lambert's law.
14. To determine Alkalinity water sample.
15. Determination of rate of corrosion of metal.
16. To determine the maximum wavelength of absorption of a given solution by colorimeter.
17. Experiment on Chromatography.

Reference Books:
1. Systematic experiments in Chemistry, A. Sethi, New Age International Publication, and New Delhi.
2. Practical Inorganic Chemistry, A. I. Vogel, ELBS Pub.
3. Practical in Engineering Chemistry, S. S. Dara.

Engineering Mathematics – II	04 Credits

Course Objectives:
1. To know and discuss the need and use of complex variables to find roots, to separate complex quantities and to establish relation between circular and hyperbolic functions.
2. To understand and solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.
3. To determine Fourier series representation of periodic functions over different intervals.
4. To demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
5. To know and apply the principles of vector integration to transform line integral to surface integral, surface to volume integral &vice versa using Gree's, Stoke's and Gauss divergence theorems.

Course Outcomes:
Students will be able to:
CO1: Discuss the need and use of complex variables to find roots, to separate complex quantities and to establish relation between circular and hyperbolic functions.
CO2: Solve first and higher order differential equations and apply them as a mathematical modelling in electric and mechanical systems.
CO3: Determine Fourier series representation of periodic functions over different intervals.
CO4: Demonstrate the concept of vector differentiation and interpret the physical and geometrical meaning of gradient, divergence &curl in various engineering streams.
CO5: Apply the principles of vector integration to transform line integral to surface integral, surface to volume integral &vice versa using Green"s, Stoke"s and Gauss divergence theorems.

Unit I: Complex Numbers
Definition and geometrical representation ; De-Moivre"s theorem(without proof) ; Roots of complex numbers by using De-Moivre"s theorem ; Circular functions of complex variable – definition ; Hyperbolic functions ; Relations between circular and hyperbolic functions ; Real and imaginary parts of circular and hyperbolic functions ; Logarithm of Complex quantities.

Unit II: Ordinary Differential Equations of First Order and First Degree and Their Applications
Linear equations; Reducible to linear equations (Bernoulli's equation); Exact differential equations; Equations reducible to exact equations ; Applications to orthogonal trajectories , mechanical systems and electrical systems.

Unit III: Linear Differential Equations with Constant Coefficients

Introductory remarks - complementary function, particular integral; Rules for finding complementary functions and particular integrals; Method of variation of parameters; Cauchy's homogeneous and Legendre's linear equations.

Unit IV: Fourier Series

Introductory remarks- Euler's formulae ; Conditions for Fourier series expansion – Dirichlet's conditions ; Functions having points of discontinuity ; Change of interval ; Odd and even functions expansions of odd and even periodic functions ; Half-rangeseries.

Unit V: Vector Calculus

Scalar and vector fields:Gradient, divergence and curl; Solenoidal and irrotational vector fields; Vector identities (statement without proofs); Green's lemma, Gauss's divergence theorem and Stokes' theorem (without proofs).

Text Books

1. Higher Engineering Mathematics by B. S. Grewal, Khanna Publishers, NewDelhi.
2. Advanced Engineering Mathematics by Erwin Kreyszig, John Wiley & Sons, NewYork.
3. A Course in Engineering Mathematics (Vol II) by Dr. B. B. Singh, Synergy Knowledge ware, Mumbai.
4. A Text Book of Applied Mathematics (Vol I & II) by P. N. Wartikar and J. N. Wartikar, Pune Vidyarthi Griha Prakashan, Pune.
5. Higher Engineering Mathematics by H. K. Das and Er. Rajnish Verma, S. Chand & CO. Pvt. Ltd., New Delhi.

Reference Books

1. Higher Engineering Mathematics by B. V. Ramana, Tata McGraw-Hill Publications, New Delhi.
2. A Text Book of Engineering Mathematics by Peter O" Neil, Thomson Asia Pte Ltd. , Singapore.
3. Advanced Engineering Mathematics by C. R. Wylie & L. C. Barrett, Tata Mcgraw-Hill Publishing Company Ltd., New Delhi.

General Instructions:

1. The tutorial classes in Engineering Mathematics-II are to be conducted batchwise. Each class should be divided into three batches for the purpose.
2. The internal assessment of the students for 20 marks will be done based on assignments, surprise tests, quizzes, innovative approach to problem solving and percentage attendance.
3. The minimum number of assignments should be eight covering all topics.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Engineering Mathematics II	Prof. Jitendra Kumar	IIT Kharagpur

Basic Electrical & Electronics Engineering   03 Credits

Course Objectives:
1. To know and apply basic ideas and principles of electrical engineering.
2. To Identify protection equipment and energy storage devices.
3. To differentiate electrical and electronics domains and explain the operation of diodes and transistors.
4. To acquire knowledge of digital electronics
5. To design simple combinational and sequential logic circuits.

Course Outcomes:
Students will be able to:
CO1: Apply basic ideas and principles of electrical engineering.
CO2: Identify protection equipment and energy storage devices.
CO3: Differentiate electrical and electronics domains and explain the operation of diodes and transistors.
CO4: Acquire knowledge of digital electronics
CO5: Design simple combinational and sequential logic circuits.

Unit I: Elementary Electrical Concepts:
Fundamental of Electrical system Potential difference, Ohm's law, Effect of temperature on resister, resistance temperature coefficient, Electrical wiring system: Study of different wire gauges and their applications in domestic and industry. Energy Resources and Utilization: Conventional and nonconventional energy resources; Introduction to electrical energy generation from different resources, transmission, distribution and utilization, Advantages & Disadvantages of AC & DC transmission. Concept of Supply Demand, Power Factor, Need of unity factor.

Unit II: Measurement of Electrical Quantities:
Measurement of Voltage, Current, and Power; Measurement of 3 phase power; Study of Energy meters. Study of Electrical Storage devices: Batteries such as Nickel-cadmium (NiCd), Lithium- ion (Li-ion), Lithium Polymer (Li-pol.) batteries. Study of circuit breakers & Actuators (MCB & MPCB, Power Contactors & Aux contactors, Electro-Mechanical & Solid state Relays)

Unit III: Diodes and Circuits:
The P-N Junction Diode, V-I characteristics, Diode as Rectifier, specifications of Rectifier Diodes, Half Wave, Full wave, Bridge rectifiers, Equations for I_{DC}, V_{DC}, V_{RMS}, I_{RMS}, Efficiency and Ripple Factor for each configuration. Filters: Capacitor Filter, Choke Input Filter, Capacitor Input Filter (Π Filter), Zener Diode, Characteristics, Specifications, Zener Voltage Regulator and Types of Diodes: LED, Photodiode

Unit IV: Semiconductor Devices and Applications:
Transistors: Introduction, Classification, CE, CB, and CC configurations, α, β, concept of gain and bandwidth. Operation of BJT in cut-off, saturation and active regions (DC analysis). BJT as an amplifier, biasing techniques of BJT, BJT as a switch.

Introduction to Digital Electronics: Number System, Basic logic Gates, Universal Gates, Boolean Postulates, De-Morgan Theorems

Reference/Text Books:
1. V. N. Mittal and Arvind Mittal, Basic Electrical Engineering, McGraw-Hill Publication.
2. Brijesh Iyer and S. L. Nalbalwar, A Text book of Basic Electronics, Synergy Knowledge ware Mumbai, 2017.ISBN:978-93-8335-246-3
3. Vincent DelToro, Electrical engineering Fundamentals, PHI Publication, 2nd Edition, 2011.
4. Boylstad, Electronics Devices and Circuits Theory, Pearson Education.
5. Edward Hughes, Electrical Technology, Pearson Education.
6. D. P. Kothari and Nagrath, Theory and Problems in Electrical Engineering, PHI Publication, 2011.
7. B. L. Theraja, Basic Electronics, S. Chand Limited, 2007.
8. Millman Halkias, Integrated Electronics-Analog and Digital Circuits and Systems, McGraw-Hill Publication, 2000.
9. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
10. Donald Neaman, Electronic Circuit Analysis and Design, McGraw-Hill Publication, 3rd Edition.
11. Printed Circuit Boards Design &Technology, WalterC. Bosshart, McGraw-Hill Publication.

Note: Students are advised to use internet resources whenever required.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
2.	Basic Electrical Technology	Prof. N.K. De, Prof. G.D. Roy, Prof. T.K. Bhattacharya	IIT Kharagpur
3.	Basic Electronics and Lab	Prof. T.S. Natarajan	IIT Madras
4.	Basic Electronics	Prof. Mahesh B. Patil	IIT Bombay

Basic Electrical & Electronics Engineering Lab   01 Credit

At least 08 experiments should be performed from the following list

List of Experiments:

1. Measure voltage current and power in 1 phase circuit with resistive load.
2. Measure voltage current and power in R L series circuit.
3. Determine transformation ratio (K) of 1 phase transformer
4. Connect single phase transformer and measure input output quantities.
5. Identify various passive electronic components in the given circuit.
6. Connect resistors, capacitors in series and parallel combination on bread board and measure its value using multimeter.
7. Identify various active electronic component in the given circuit.
8. Test the performance of PN junction diode.
9. Test the performance of Zener diode.
10. Test the performance of NPN transistor.

Engineering Mechanics   03 Credits

Course Objective:
The objective of this Course is to provide an introductory treatment of Engineering Mechanics to all the students of engineering, with a view to prepare a good foundation for taking up advanced courses in the area in the subsequent semesters.

Course Outcomes:
Students will be able to:
CO1: To develop ability to model and analysis of mechanical engineering systems using vectoral representation of forces and moments.
CO2: To be able to draw the free body diagrams of mechanical components and systems.
CO3: Ability to draw shear force diagram and banding moment for different types of beams taking into consideration their elastic nature.
CO4: To understand the phenomenon of friction and ability to solve problem related to the same. Ability to apply the principles of virtual work.

Unit I:
Transformation of scalars and vectors under Rotation transformation; Forces in Nature; Newton's laws and its completeness in describing particle motion; Form invariance of Newton's Second Law; Solving Newton's equations of motion in polar coordinates; Problems including constraints and friction; Extension to cylindrical and spherical coordinates.

Unit II:
Potential energy function; $F = -$ Grad V, equipotential surfaces and meaning of gradient; Conservative and non-conservative forces, curl of a force field; Central forces; Conservation

of Angular Momentum; Energy equation and energy diagrams; Elliptical, parabolic and hyperbolic orbits; Kepler problem; Application: Satellite manoeuvres;

Unit III:
Non-inertial frames of reference; rotating coordinate system: Five-term acceleration formula, Centripetal and Coriolis accelerations; Applications: Weather systems, Foucault pendulum;

Unit IV:
Harmonic oscillator; Damped harmonic motion – over-damped, critically damped and lightly damped oscillators; Forced oscillations and resonance.

Unit V:
Definition and motion of a rigid body in the plane; Rotation in the plane; Kinematics in a coordinate system rotating and translating in the plane; Angular momentum about a point of a rigid body in planar motion; Euler's laws of motion, their independence from Newton's laws, and their necessity in describing rigid body motion; Examples.

Unit VI:
Introduction to three-dimensional rigid body motion — only need to highlight the distinction from two-dimensional motion in terms of (a) Angular velocity vector, and its rate of change and (b) Moment of inertia tensor; Three-dimensional motion of a rigid body wherein all points move in a coplanar manner: e.g. Rod executing conical motion with center of mass fixed — only need to show that this motion looks two-dimensional but is three-dimensional, and two-dimensional formulation fails.

Reference Books:
1. Engineering Mechanics, 2nd ed. — MK Harbola
2. Introduction to Mechanics — MK Verma
3. An Introduction to Mechanics — D Kleppner & R Kolenkow.
4. Principles of Mechanics — JL Synge & BA Griffiths
5. Mechanics — JP Den Hartog
6. Engineering Mechanics - Dynamics, 7th ed. - JL Meriam
7. Mechanical Vibrations — JP Den Hartog
8. Theory of Vibrations with Applications — WT Thomson

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Engineering Mechanics	Prof. K. Ramesh	IIT Madras

Energy and Environment Engineering   01 Credit

Course Objectives
1. To impart the knowledge of environmental education to the students of Engineering and Technology.
2. To explain basic knowledge and concept of causes, effects and control measures of environmental pollution and
3. To understand the role of individual for the protection of Environment.

Course Outcomes
Student should able to:
1. Know and understand about components and segments of environment, ecosystem and its types.
2. Understand and explain various types of air pollution, their effects and control measures.
3. know the various types of water pollution, sources, waste water treatment, effect of water pollution on health
4. understand the sources, effects and control measures of soil & noise pollution
5. Know the sources and types of solid waste, its management and role of individual in pollution prevention.

Unit I: Environment
Introduction, Components of Environment, Types of Environment, Brief discussion on Segments of Environment, Environmental Pollution, Ecosystem-Types of Ecosystem, Components of Ecosystem.

Unit II: Air Pollution
Introduction, Brief discussion on air pollutants, Sources of Air Pollution- Pollutants from Industry, Pollution by Automobiles; Effect of Air Pollutions-Acid rain, Green House Effect, Global warming; Brief discussion on Control of Air Pollution.

Unit III: Water Pollution
Introduction, Types of Water Pollutants, Sources of Water Pollution, Methods to remove impurities in water, Treatment of Waste water, Impact of Water Pollution on Human Health, Water as a carrier for the transmission of diseases.

Unit IV: Soil & Noise Pollution
Sources of Soil Pollution, Harmful effects of Soil Pollution, Control of Soil Pollution, Noise Pollution- Sources, Effects and Control Measures of Noise Pollution.

Unit V: Solid Waste Management
Classification of Solid waste- Sources and Types of Solid Waste, Causes of Solid Waste Solid Waste Management- Disposal of Solid Waste, Recycling of Solid Waste Awareness of Environment, Role of Individuals in Pollution Prevention.

Reference Books:
1. Environmental Science, V. K. Ahluwalia and Sunita Malhotra
2. Environmental Chemistry (sixth edition), A. K. De
3. Essential Environmental Studies, S. P. Mishra and S. N. Pandey

Energy and Environment Engineering laboratory   01 Credit

List of Experiments:
1. Experiments on Air Pollution.
2. Experiments on Water Pollution.
3. Experiments on Soil Pollution.

Reference Books:
1. Environmental Chemistry (sixth edition), A. K. De
2. A Textbook of Engineering Chemistry, Dr. S. S. Dara and Dr. S. S. Umare
3. Textbook On Experiments & Calculations In Engineering Chemistry: Ss Dara (Author), S Chand & Company Pvt Ltd - He (Publisher)

Introduction to Petrochemical Engineering   02 Credits

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

CO1: Understand the basic concepts of Petrochemical and Chemical Engineering.
CO2: Understand the material and energy balances of chemical processes.
CO3: Understand the analogy among fluid and heat transfer.
CO4: Understand the concepts related to mass transfer operations and chemical kinetics.
CO5: Analyse the effect of pollution on environment.

Detailed syllabus:

Unit I: Origin, Formation and Composition of Petroleum
Origin and formation of Petroleum, Reserves and deposits of world, Indian Petroleum Industry, Composition of Petroleum, Petroleum Refinery Processes and operations, Petroleum Refinery flow schemes, Definitions of Refining terms

Unit II: Introduction to Unit operations and Process Calculations
Development of flow diagrams, Basic tools of Chemical Engineering Physico-Chemical Calculations, Physiochemical Calculation, Material and Energy balances.

Unit III Transport Processes
Flow of fluids: Basic concept of transfer process, principles and application of flow of fluid and solids
Measuring devices: Density and specific gravity, Viscosity, humidity, pH, Pressure, Temperature, Flow meters, Level indicators.
Heat Transfer: Basic mode of heat transfer, Heat exchangers, Evaporation.

Unit IV Fundamentals of mass transfer and Chemical kinetics
Mass Transfer: Diffusion in Fluids, Distillation, Gas Absorption, Liquid–liquid Extraction, Leaching, Humidification, Dehumidification, Drying and Crystallization, Adsorption.
Chemical Kinetics: Introduction, Thermodynamic review, Determination of the rate equation, Catalysis, Reactors.

Unit V Computer Application, Resources and Production
Computer Application: Modelling and simulation, Computer and their application.
Natural resources and their utilization: Renewable raw materials, Non – Renewable material. Pollution and abatement, Case studies on refineries- Cement, Paper and pulp, Textile and Ceramic industries.

Text Book:
1. S.K. Ghosal S. K. Sanyal and S. Datta Introduction to chemical Engineering TMH Book company 1998.
2. Anderson L.B. and L.A. Wenzel Introduction to chemical Engineering Mcgraw Hill Book Company 1998.
3. B. K. Bhaskara Rao, *Modern Petroleum Refining Processes*, Oxford and IBH Publishing Co. Pvt. Ltd., New Delhi, 2005, Fourth Edition.
4. G.N. Sarkar, *Advanced Petroleum Refining*, Khanna Publishers, Delhi, First Edition, 1998.

Workshop-Manufacturing Practices	02 Credits

Course Objectives:
1. To provide exposure to the students with hands on experience on various basic engineering practices in Civil, Mechanical, Electrical and Electronics Engineering.
2. To have a study and hands-on-exercise on plumbing and carpentry components.
3. To have a practice on gas welding, foundry operations and fitting.
4. To have a study on measurement of electrical quantities, energy and resistance to earth.
5. To have a practice on soldering.

Laboratory Outcomes:
Students will be able to:
1. Upon completion of this laboratory course, students will be able to fabricate components with their own hands.
2. They will also get practical knowledge of the dimensional accuracies and dimensional tolerances possible with different manufacturing processes.
3. By assembling different components, they will be able to produce small devices of their interest.

Workshop Practices
1. Machine shop
2. Fitting shop
3. Carpentry
4. Electrical & Electronics
5. Welding shop

6. Casting

7. Smithy

8. Plastic moulding& Glass Cutting

Examinations could involve the actual fabrication of simple components, utilizing one or more of the techniques covered above.

Text/Reference Books:

1. AICTE's Prescribed Textbook: Workshop / Manufacturing Practices (with Lab Manual) ISBN: 978-93-91505-332.
2. Hajra Choudhury S.K., Hajra Choudhury A.K. and Nirjhar Roy S.K., "Elements of Workshop Technology", Vol. I 2008 and Vol. II 2010, Media promoters and publishers private limited, Mumbai.
3. Kalpakjian S. And Steven S. Schmid, "Manufacturing Engineering and Technology", 4th edition, Pearson Education India Edition, 2002.
4. Gowri P. Hariharan and A. Suresh Babu," Manufacturing Technology – I" Pearson Education, 2008.
5. Roy A. Lindberg, "Processes and Materials of Manufacture", 4th edition, Prentice Hall India, 1998.
6. Rao P.N., "Manufacturing Technology", Vol. I and Vol. II, Tata McGraw Hill House, 2017.

IKS Subjects	02 Credits

Indian Art: Materials, Techniques and Artistic Practices	02 Credits

Course Objectives:

1. To introduce the diversity of art practices and material culture from the Indian subcontinent.
2. To situate these practices against their socio-cultural, political and temporal settings.
3. To support an immersive approach to understanding Indian art.
4. To bring together the recent findings in Indian art

Course Outcomes:
Students will be able to:

CO1: Draw connections between the historical artifacts and contemporary objects from the immediate surroundings.

CO2: Encourage themselves as an art practitioner, aspiring art historians, educators, and those preparing for competitive examinations in India.

CO3: Direct the possible ways of exploring these thematic.

Unit I: Clay and Architecture I

Clay: Terracotta and Terracruda, How is clay processed into objects?, Brick structures and urns from the Indus Valley and Megalithic sites in south India, Sculptures of terracotta and bronze from Harappa, Terracruda or unbaked clay-made objects and rituals.

Architecture I: Basics of Buddhist and Jain architecture- Wood, stone and living rock, Stupa, vihara, caves and temples from Shunga, Kushana, Maurya and Gupta periods.

Unit II: Pigment and Architecture II

Pigment: Mineral and vegetal colours- How pigment-based paints are processed and applied to walls Bhimbetka drawings, Murals of Sittanavasal and Ajanta.

Architecture II: Hinduism and temple building- Architectural treatise and utilisation of Vastupurusha mandala for making temples, Temples of Badami Chalukyas, Rashtrakuta, Chola, Chandela and Eastern Ganga dynasties.

Unit III: Stone and Garden

Stone: Memorials, Architectural Remnants and Objects- Types of stone in India: Mathura Sandstone, Deccani Basalt, Rajasthani Marble, Stone carving for architecture, Hero stones and their social significance, Household items and objects in royal court.

Garden: Islam, the garden of paradise and afterlife, Tombs, palace, garden and waterways from the Mughal and Deccani context**,** Regional and foreign flora and fauna in Mughal and Deccani gardens.

Unit IV: Paper and Printing

How does paper affect the character of painting and calligraphy? How are ink and pigments prepared? Jain manuscripts and Islamic treatise, Mughal, Deccani, Rajput and Pahari miniature paintings, Mysore and Tanjore paintings.

Printing: European Interventions -Printmaking techniques and their application in books and images, Bazar paintings of Kalighat and Battala woodcuts**,** Lithograph and Oleograph from Calcutta, Pune and Lucknow

Unit V: Multimedia Approaches

Introduction to the key developments in Indian Art after 1947, Post-independence artistic and design practices, Canvas painting, textile, furniture making between the 1950s and 1990s, Neoliberalism, transnational connections and "new media" approaches, Curatorial and collaborative projects between artists, educators and communities, Biennale, entrepreneurship and expansive notion of "art" after 2010.

Text Books/References:

1. Ali, Daud and Emma Flatt eds. 2020. Garden and landscape practices in pre-colonial India: histories from the Deccan. New Delhi: Routledge.
2. Dehejia, Vidya. 2006. Chola: Sacred Bronzes of Southern India. London: Royal Academy of Arts.
3. Goswamy, B. N., and Eberhard Fischer. 2017. Pahari Paintnings: The Horst Metzger collection in the Museum Rietberg. New Delhi: Niyogi Books.
4. Hardy, Adam. 2007. The Temple Architecture of India. Chichester (GB): J. Wiley and Sons.

5. Huntington, Susan. 1993. The Art of Ancient India: Buddhist, Hindu, Jain. New York: Weatherhill.
6. Koch, Ebba. 2001. Mughal Art and Imperial Ideology: Collected Essays. New Delhi: Oxford University Press.
7. Meister, Michael and M. A. Dhaky. 1999. Encyclopedia of Indian Temple Architecture. New Delhi: Manohar Publishers.
8. Mitter, Partha. 2001. Indian Art. Oxford and New York: Oxford University Press.
9. Sengupta, Paula. 2012. The Printed Picture: Four Centuries of Indian Printmaking. New Delhi: Delhi Art Gallery.
10. Singh, Kavita, ed. 2018. Scent upon a Southern Breeze: the synaesthetic arts of the Deccan. Mumbai: Marg.
11. Subramanyan, K. G. 2007. The Magic of Making: Essays on Art and Culture. Calcutta: Seagull.

General Meteorology	02 Credits

Course Objectives:
1. To give an overview of science of meteorology.
2. Be aware of the working of world meteorological organization and different met communications/telecommunication network in India.
3. To make aware of effect of physical geography and earth's interior on meteorology.

Course Outcomes:
Students will be able to:
CO1: Remember various components of world meteorological organizations. (Remember)
CO2: Understand the met communications, telecommunications network in India and channels used in IAF. (Understand)
CO3: Understand the effect of physical geography, motions of the earth and on meteorological process. (Apply)
CO4: Apply the knowledge of earth's interior to analyse the meteorological phenomena. (Analyze)
CO5: Evaluate the measurement of time in prospective of meteorology. (Evaluate)

Unit I: Science of Meteorology- An Overview
Introduction to meteorology, History of meteorology, General circulation.

Unit II: Meteorological Organisation
World meteorological organization (WMO), Regional met centers, Indian Meteorological Department, Met organization in Indian Air force.

Unit III: Motion of Earth and Measurement of Time
Introduction, Orbital and rotational characteristics of earth, Conversion of time and sidereal time.

Unit IV: Physical Geography and Structure of Earth
Insolation, The earth and its interior, Impact of physical geography.

Unit V: Met Telecommunication
Global Telecommunication System, National Data Exchange Network, Meteorological Telecommunications in IAF.

Text Books:
1. WMO Training Manuals.
2. Manual of Meteorology for Air Crew - IAF Publication
3. General Meteorology – Byers HR.

Reference Books:
1. Training Notes. Dept of Meteorology - AFA(Volume – 3)
2. Meteorology for Airman in India Part I – I Met D.

NSS-II	02 Credits

Unit I: Life Competencies and skill
Definition and importance of life competencies, Communication, Inter Personal, Problem solving and decision making, Positive thinking, Self-confidence and self-esteem, Life goals, Stress and time management

Unit II: Social Harmony and National Integration
Indian history and culture, Role of youth in peace-building and conflict resolution, Role of youth in Nation building

Unit III: Youth Development Programmes in India
National Youth Policy, Youth development programmes at the National Level, State Level and voluntary sector, Youth-focused and Youth-led organizations

Health and Wellness	02 Credits

Course Objectives:
1. To systematically addresses the issues of health, adjustment and well-being.
2. To provide insights from the field of psychology to make your life more satisfying and meaningful.

Course Outcomes:
Students will be able to:
CO1: Learn how to deal with mental distress and disorders
CO2: Understand and enhance positive mental health and wellbeing particularly in the field of psychology.
CO3: Gain happiness and well-being theory and research to enrich the understanding of both negative and positive side of human behaviour.

Unit I: Psychology of happiness
What is happiness? What makes us happy? Socio-economic factors and happiness; Positive emotions

Unit II: Can we become happier?
Genetic set-point and hedonic adaptation; Sustainable happiness model and intentional activities

Unit III: Happiness Activities 1
Expressing gratitude and positive thinking; Love and kindness; Avoiding overthinking and social comparison

Unit IV: Happiness Activities 2
Identifying signature strengths; Achieving happiness with "Flow".

Unit V: Is happiness sufficient?
The concept of eudaimonic well-being; Self-determination and motivation

References:

1. W. Weiten, and M. A. Lloyd, Psychology Applied to Modern Life: Adjustment in the 21st Century, Wadsworth Publishing, 2007
2. R. Harington, Stress, Health and well-being: Thriving in the 21st century, Wadsworth Publishing, 2013.
3. I. Boniwell, Positive psychology in a nutshell, McGraw-Hill Education, 2012.
4. S. Lyubomirsky, The how of happiness, Penguine Press, 2008.

Alternative NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Psychology of Stress, Health and Well-being	Prof. Dilwar Hussain	IIT Guwahati

Study from Still Life	**02 Credits**

Course Objective:
The students should be able to develop potential for creativity, self-expression and visual awareness through painting. The students should be able feel confident with the chosen medium as a means of communicating and generating ideas. Also they should develop observation, recording, manipulation, application skills and understand the basic principles of colour.

Course Outcomes:
Students will be able to:
CO1: Understand the objects shape and form.
CO2: Understand the principle of still life, dimension with tone, texture etc.
CO3: Understand the elements of still life composition and principle of natural and man-made objects etc.
CO4: Develop potential for creativity, self-expression and visual awareness through painting.

Detailed contents:
Unit I:
Introduction of Course & Still Life, Elements of Art.

Unit II:
Sketching and Drawing, Geometrical Form & Shape, Symmetrical and Non-symmetrical object sketching.

Unit III:
Use of Line, Tone & Shading, Single Symmetrical & Non-symmetrical Object still life.

Unit IV:
Nature study with Objects, Vegetable Study with Objects.

Unit V:
Objects study with Drapery, Group Objects & Nature Study, Object study with Oil colour.

References:

1. NPTEL/SWAYAM Course:

S. No.	NPTEL Course	Name Instructor	Host Institute
1.	Study from Still Life	Dr. Lakshaman Prasad	Indira Gandhi National Open University

Hindustani Music	**02 Credits**

Course Objectives:
1. To appreciate the diversity and uniqueness in Hindusthani

Course Outcomes:
Students will be able to:
CO1: Learn three vibrant genres of Dhrupad, Khayal and Instrumental Music which this course explores with a focus on Khayal.
CO2: Do contemporary practice while also drawing upon historical and textual scholarship to place the music in perspective.
CO3: Get benefits from highly regarded musicians, musicologists and scholars and guided listening of recorded music.

Unit I: Hindustani Music
A World of Colour, Romance, and History,
Classical or Shastriya – What's in a Name!
Dhrupad, Khayal and Instrumental Music – A Bird's-eye View.
Hindustani Music as Raga Sangeet,
The Textual Tradition,
Swara and Shruti: Tone and Microtone,
Swara and Shruti in the Textual Tradition,
Tanpura – The King of Overtones,
Entering the World of Raga – Raga and Swara,
The World of Raga – 2: Strong and Weak Notes,

The World of Raga – 3: Ornament,
The World of Raga – 4: Paths of a Raga,
Raga and Time Association

Unit II: Raga Lakshana or Features of Raga

Defining Raga,
Classification of Ragas – the Mela or Thaat System,
Classification of Ragas – the Raagaanga System,
Classification of Ragas – the Raga Ragini system.
Extending the Raga Corpus – Winds from the South,
Extending the Raga Corpus– Jod Ragas,
Principles of Time in Hindustani Music – Tala and Laya,
Some Aspects of Tala and a Few Important Tala-s, Tabla as Keeper of Tala in Khayal,
Khayal-A Compositional Form, Some Contemporary Composers of Khayal.

Unit III: The Vilambit Khayal Improvisation in Khayal

Elements of Raga Vistaar., The Eight Limbs or Ashtaanga of Khayal and the nature of Tabla accompaniment., A Typical Khayal Presentation, Raga Profiles as Captured in Bandish
Gharanas of Hindustani Music – Introduction
Gharanas of Hindustani Music – Early Masters
Gharanas of Hindustani Music – Twentieth Century masters
Gharanas of Hindustani Music – Melodic accompaniment in Khayal
The Harmonium as a solo and accompanying instrument.

Unit IV: Dhrupad

Style and structure, alaap, compositional forms, song texts:The Enchanting World of Thumri
Instrumental Music – an Introduction
The Sarod: A Lecture demonstration by Pt Suresh Vyas
The Sitar: A Lecture demonstration by Dr Supriya Shah

Reference:

1. NPTEL/SWAYAM Course:

S. No.	NPTEL Course Name	Instructor	Host Institute
1	Hindustani Music	Prof. Lakshmi Sreeram, Prof. Srijan Deshpande	IIT Madras, Manipal Academy of Higher Education, Manipal