ESSENTIALS of NCC

B.E., V Semester (Open Elective)

[As per Choice Based Credit System (CBCS) scheme]

Prerequisite: Active NCC Cadet or one who has completed B/C certificate in NCC can opt this Elective.

Subject Code	15NC561	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours / Module)	Exam Hours	03
CREDITS – 03			

Modules

Module-1

NCC Organisation, Armed Forces and National Integration & Awareness

Introduction to NCC organisation, important basic aspects of drill including ceremonial drill, drill with arms and words of command.

Introduction and general information about the Armed Forces. Organisation of Army, Task & Role of Fighting Arms, Supporting Arms & Services. Modes of Entry to Army, Honours and Awards, Concept of Integrated Defence Staff. Biographies of renowned Generals. Indian Army War Heroes – PVCs.

The concepts of National Interests, Objectives and Integration, unity in diversity and cultural heritage of India. National Integration Council, Contribution of Youth in Nation Building.

Text1: ch1,2 & 3 Text2: ch1 & 5

Module-2

Personality Development & Leadership -I

Introduction to Personality Development, Leadership with emphasis on self-awareness, life/ soft skills, time management and character building.

Factors Influencing / shaping Personality, Self-Awareness, Interpersonal relationship and communication, Communication Skills. Leadership Traits, Types of Leadership.

Text1:ch5

Module-3

Personality Development & Leadership –II

Attitude and Time Management. Effects of Leadership with historical examples.
Stress Management Skills, Interview Skills, Importance of Group / Team Work,

Influencing Skills, Body Language, Social Skills, Values / Code of Ethics.

Introduction to various Adventure activities such as Para Sailing, Slithering, Rock Climbing, Cycling/ trekking.

Text1:ch5 & 9

Module-4

Environment Awareness & Conservation, Social Awareness & Community development and Disaster Management

Basic understanding of environment conservation and waste management. Understanding of social service and its needs, knowledge about the weaker sections of our society and their requirements, about NGOs and contribution of youth towards social welfare.

Drug Abuse & Trafficking, Civic Responsibilities. Role of youth in Counter Terrorism, Corruption and Social Evils .

RTI & RTE, Provisions of Protection of Children from Sexual Harassment Act 2012

Civil Defence Organisation and its duties, Assistance during Natural/Other Calamities Health & Hygiene: Health, hygiene, sanitation, diseases and an elementary knowledge of First-Aid and Nursing. Physical & Mental Health. Introduction to Yoga & Exercises.

Text1: ch6,7,8 &10

Module-5

Weapons, Map Reading, Field Craft & Battle Craft and Latest trends in the field of communications

Understanding of maps and map reading instruments.
Basics of Field Craft and Battle Craft.
Introduction to trends in the field of communications in Indian army.

Introduction to characteristics and capabilities of Infantry weapons, Infantry Company Support Weapons and Infantry Battalion support weapons.

Text1:ch4 Text2:ch2,3, 4 &6

Course Outcomes:

- Students will develop qualities like Character, Comradeship, Discipline, Leadership, Secular Outlook, Spirit of Adventure, ethics and Ideals of Selfless Service.
- Students will get motivated and trained to provide Leadership in all Walks of life and be Always Available for the Service of the Nation.
- Students will be aware on the issues related to conservation of Environment, Social & Community development and Disaster Management and equipped

themselves to provide solutions.

- Students will get an insight into the defence forces and get motivated to join the defence forces

Delivery Method:

1. Blackboard / Multimedia Assisted Teaching
2. Class room Discussions, Brainstorm Sessions
3. Inductive Teaching: Case-based instruction
4. Activity: Organising/Participation in Social Service Programs

Text Books:

1. NCC Cadets Handbook – Common, Directorate General of NCC, New Delhi.
2. NCC Cadets Handbook – Special, Directorate General of NCC, New Delhi.

Reference Books:

1. Chandra B. Khanduri, "Field Marshal KM Cariappa: a biographical sketch", Dev Publications, 2000
2. Gautam Sharma, "Valour and Sacrifice: Famous Regiments of the Indian Army", Allied Publishers, 1990
3. Warren G. Bennis, "On Becoming a Leader", Perseus Books, 1989

LASER PHYSICS AND NON-LINEAR OPTICS

B.E., V Semester (Open Elective)

[As per Credit Based Choice System]

Subject Code	15PHY561	IA Marks	20
Number of Lecture Hours/Week	03	Exam Hours	03
Total Number of Hours	40 (08 Hours per week)	Exam Marks	80

Course Objectives:

To enable the students to understand the mode of working of different types of Laser with relevant theoretical background and their applications in various fields.

Module-1

Theory of Vibrations and Resonance: Equation for simple harmonic motion, Differential equation for SHM, Free vibrations, natural frequency of vibration, Damped vibration, Analytical treatment of Damped vibration, Cases of Over damping, critical damping & Under damping, Forced Vibrations, Analytical treatment of forced vibrations, condition for resonance, effects of resonance with examples (Tacoma bridge collapse), sharpness of resonance, Applications of resonance: Acoustic cavity resonance, Laser cavity resonance.

L1, L2, L3, L4

Module-2

Types of Lasers: Review of basic principles, Types of Laser: Nd-YAG Laser, Liquid Laser, Dye Laser (Rhodamine 6-G), Chemical Laser (HF Laser), Excimer Laser, Qualitative discussion of Free electron Laser and X-ray Laser, Laser amplifiers.

L1, L2

Module-3

Applications of Lasers:

Defense applications: Laser range finder and Laser guided antitank missile, Industrial applications: Data storage and Laser printing,
Research and development applications: Lithography, Laser cooling, Laser fusion and isotope separation. Biomedical applications: Eye surgery, Endoscopy and Dentistry.

L1, L2

Module-4

Optical Communication: Review of basic principles of Optical fibers, fiber materials, fiber fabrication, Vapor-deposition methods, Fiber optic cables, optical fiber connections, joints and couplers, attenuation and dispersion in optical fibers, Industrial, medical and technological applications of optical fiber, Fiber optic sensors -Intensity modulated, phase modulated and polarization modulated sensors.

L1, L2, L3

Module-5

Nonlinear Optics: Relevance of Nonlinear optics in Laser technology,

descriptions of nonlinear optical processes, formal definition of the nonlinear susceptibility, nonlinear susceptibility of a classical an harmonic oscillator, properties of the nonlinear susceptibility, time-domain description of optical nonlinearities, Derivation of Kramers–Kronig relations in linear and nonlinear optics. The wave equation for nonlinear optical media, coupled-wave equations for sum-frequency generation, phase matching, quasi-phase-matching, the Manley–Rowe relations, sum-frequency generation, second-harmonic generation, difference-frequency generation and parametric amplification, optical parametric oscillators.

L1, L2, L3

Course Outcomes:

1. Able to distinguish and analyze different types of vibrations.
2. Able to understand fabrication and working of different types of Lasers.
3. Learn the applications of Lasers in various fields.
4. Acquire the knowledge of optical fibers and appreciate its applications in sensor designing.
5. Understand the basics of nonlinear phenomena from the fundamental perspective of quantum mechanics.

Text Books/ Reference Books:

1. *Engineering Physics,* R. K. Gaur and S. L. Gupta, Dhanpath Rai and Sons.
2. *Lasers: Theory and Applications*, K. Thyagarajan and A.K. Ghatak, Springer (1981).
3. *Laser and Fundamentals*, W. T. Silfvast, Cambridge University Press (2004).
4. *Introduction to optical fiber*, A.K.Ghatak, Cambridge University Press.
5. *Lasers and Nonlinear optics*, B. B. Laud, John Wiley & Sons Inc. (1985).
6. *Nonlinear optics by* Robert W. Boyd (3rd edition).
7. *Essentials of Nonlinear optics by* Y.G.S. Murthy and C. Vijayan.

ADVANCED PHYSICS FOR ENGINEERS

B.E., VI Semester (Open Elective)

[As per Choice Based Credit System (CBCS) scheme]

Subject Code	15PHY661	IA Marks	20
Number of Lecture Hours/Week	03	Exam Marks	80
Total Number of Lecture Hours	40 (08 Hours / Module)	Exam Hours	03
CREDITS – 03			

Course Objectives:

To enable the students to gain the knowledge of Quantum mechanics, Raman spectroscopy and its theoretical background with applications, Quantum computation, Nuclear and environmental hazards with their implications and Special theory of relativity and its relevance in latest applications.

Module-1

Raman Spectroscopy: Scattering of light, Coherent and incoherent scattering with examples. Raman effect, Stoke's and antistoke's lines, Characteristics of Raman spectra,

Experimental study of Raman effect, Classical and Quantum theory of Raman effect. Different energy levels in molecules, Rotational energy levels, Derivation of the expression for rotational energy of a diatomic molecule, Mention of the expression for vibrational energy, Selection rules, Rotational and Vibrational Raman spectra (qualitative), Resonance Raman effect, Comparison between Raman effect and Resonance Raman effect.

Applications of Raman spectroscopy (qualitative), Detailed discussion of role of Raman spectroscopy in Forensic science, Environmental studies and Industrial applications, Problems.

L1, L2, L3

Module-2

Quantum Mechanics: Operator formalism of Schrodinger equation (time dependent Schrodinger equation- Hamiltonian), Expectation values, Applications of Schrodinger's equation: Step potential - Determination of reflection and transmission coefficients when the energy of incident particles is (i) greater than the height of step potential ($E > V_o$) (ii) less than the height of step potential ($E < V_o$). Rectangular potential barrier, Barrier penetration and quantum mechanical tunneling, Tunneling probability (T), Applications of tunneling: Scanning Tunneling microscope (STM), Alpha decay, Tunnel diode. Harmonic oscillator – Energy and wave functions of harmonic oscillator (qualitative).

L1, L2, L3

Module-3

Quantum Computing: Beginnings of quantum computation, Classical information and quantum information, Moore's law, Maxwell's demon and Szilard's simplified model, Landauer's principle, Idea of reversibility, Superposition in quantum computation with examples (Qualitative), Concept of Qubit, Properties of Qubit-vector representations in qubit states, Superposed spin states of electron, Quantum amplitudes, rotations, Hadamord transformation, Toffoli gate, Examples of quantum computing through NMR system, Difference between classical and quantum computing.

L1, L2, L3

Module-4

Environmental Hazards: Regions of atmosphere based on vertical temperature profile, Tropospheric greenhouse gases- O_3, NO, NO_2, CO, CO_2, CH_4 and non CH_4, atmospheric aerosol particles, role of trace gases and aerosols in atmospheric energy balance. Effect of anthropogenic activities on trace gases and aerosols, surface warming, climate change, stratospheric ozone, effect of CFC's on stratospheric ozone, ozone hole.

Nuclear Hazards: Radiation: Ionizing radiation and its effects, Mutation: Genetic load, mutation rates, Background radiation, Units of radiation: Roentgen and rad, Relative biological effectiveness (RBE), Roentgen equivalent man (REM), Man-made radiation: X-Rays, Nuclear radiation, Radiation sickness, Absorption of radiation by biological beings.

L1, L2

Module-5

Special Theory of Relativity: Frames of reference, Galilean transformations, Michelson and Morley experiment-significance of negative result of the experiment, Postulates of Einstein's theory of relativity, Lorentz transformation equation - space and time, Length contraction and time dilation, Velocity addition theorem.

Relativistic expression for variation of mass with velocity, mass with energy of a particle in terms of momentum. Equivalence of mass and energy, Relevance of special theory of relativity in GPS.

L1, L2, L3, L4

Text Books/ Reference Books:

1. Concepts of Modern physics by Arthur Beiser, Tata McGraw-Hill Publishing Company Limited, New Delhi.
2. Fundamentals of Molecular Spectroscopy by Colin N. Banwell and Elaine M. McCash, Tata McGraw-Hill Publishing Company Limited, New Delhi.
3. Spectroscopy by H. Kaur, PragatiPrakashan, Meerut.
4. Quantum computation and quantum information by M.A. Nielsen and I.L. Chuang, Cambridge University Press.
5. Quantum computing – A Gentle Introduction by Eleanor G. Rieffel, Wolfgang H. Polak, MIT press.
6. Chemistry and Physics of Air pollution and climate change by John. H. Seinfield.

Course Outcomes:

1. Differentiate relativistic and non-relativistic motion and its relevance to terrestrial communication.
2. Apply the concept of quantum mechanics to tunneling problems.
3. Familiarize with the developments in modern computing.
4. Understand the basic environmental and nuclear hazards.
5. Apply the concept of Raman spectroscopy to various fields including engineering and medicine.

LINEAR ALGEBRA

BE., VI SEMESTER (Open Elective)

[As per Credit Based Choice System (CBCS)]

Subject Code:	15MAT661	**IA Marks:** 20
Number of Lecture Hours/Week:	03	**Exam Marks:** 80
Total Number of Lecture Hours:	40	**Exam Hours:** 03
	CREDITS – 03	

Course objectives:

This course will enable students to:

- Represent a system of linear equations in matrix form.
- Find the solution of the system of linear equations using elementary operations.
- Identify vector spaces, subspaces and their properties.
- Transform a vector space of one dimension to higher/another dimension.
- Decompose a given matrix using different techniques.

Modules	Teaching Hours	Revised Bloom's Taxonomy (RBT) Level
Module -1		
Linear Equations: System of linear equations, and its solution sets; elementary row operations and echelon forms; matrix operations; invertible matrices, LU-decompostion. (Text.2 Chap.1)	08 Hours	L2, L3, L4
Module -2		
Vector Spaces: Vector spaces; subspaces; bases and dimension; coordinates; summary of row-equivalence; computations concerning subspaces. (Text.1 Chap. 2)	08 Hours	L2, L3, L4
Module -3		
Linear Transformations: Linear transformations; algebra of linear transformations-rank and nullity; representation of transformations by matrices; linear functionals; inverse of a linear transformation. (Text.2 Chap.3)	08 Hours	L1, L2, L3
Module -4		
Inner Product Spaces: Inner products; inner product spaces; orthogonal sets and projections; Gram-Schmidt process; QR-decomposition; *(Ref.1 Chap. 8)*	08 Hours	L2, L3, L4
Module -5		
Symmetric Matrices and Quadratic Forms: Diagonalization; quadratic forms; constrained optimization; singular value decomposition. (Text.2 Chap.7)	08 Hours	L1, L2, L3, L4

RBT Levels:- L1 = Remembering , L2 = Understanding, L3 = Applying, L4 = Analyze

Course outcomes:

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

- Analyze whether a system is consistent or inconsistent.
- Identify whether the solution of the system is unique or infinite.
- Perform row operations on matrices and find bases and dimension.
- Linearly transform the system from one dimension to another and find the relevant transformation.
- Compute orthogonal and orthonormal basis vectors.
- Decompose a symmetric matrix using standard techniques

Graduating Attributes (as per NBA):

- Engineering Knowledge
- Problem Analysis
- Design / development of solutions(partly)
- Investigations

Question paper pattern:

- The question paper will have ten questions.
- Each full Question consisting of 16 marks. There will be 2 full questions (with a maximum of four sub questions) from each module.
- Each full question will have sub questions covering all the topics under a module.
- The students will have to answer 5 full questions, selecting one full question from each module.

TEXT BOOKS:

6. David C. Lay, “Linear Algebra and its Applications,” 3rd edition, Pearson Education (Asia) Pte. Ltd, 2005.
7. Kenneth Hoffman and Ray Kunze, "Linear Algebra," 2nd edition, Pearson Education (Asia) Pte. Ltd/ Prentice Hall of India, 2004.

REFERENCE BOOKS:

1. Bernard Kolman and David R. Hill, "Introductory Linear Algebra with Applications”, Pearson Education (Asia) Pte. Ltd, 7th edition, 2003.

2. Gilbert Strang, "Linear Algebra and its Applications”, 3rd edition, Thomson Learning Asia, 2003.