

Savitribai Phule Pune University



Post Graduate Diploma in Defence Technology (Semester and Credit System)

Syllabus

(To be implemented in 2021-2022)

**Department of Defence and Strategic Studies
Savitribai Phule Pune University
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Total No. of Seats: 40+ Army Officers

Eligibility: Minimum Graduate (Science or Engineering)

Duration: One Year

Fees: Rs. 45000/- per semester (Rs.90000/- for One Year)

Post Graduate Diploma in Defence Technology

COURSE DESCRIPTION

This course is offered by the Department of Defence Strategic Studies (DDSS) of SPPU in collaboration with the Institute of Defence Scientists and Technologists (IDST). The course will be taught mostly by the experts of retired Defence scientists and Technologists with life time experience of dealing with defence projects in all aspects. IDST is Deemed Academic Institute, extended by DRDO and recognized by DSIR.

AIMS & OBJECTIVES

This course aims at imparting basics of Defence Technologies for better understanding to bridge any gaps during progress of Defence projects with the involvement of Research and Development, Production and Quality Assurance units in Defence, Public and Private Sector. This is primarily with the objective of making available our Defence forces with State-of-the-Art equipment.

RATIONALE

India is progressing fast towards Self Reliance in Defence with the lead of DRDO and collaborative efforts of Academic Institutes, Public and Private sector in Design, Development and Production of Defence equipment needed. The equipment ranging from Underwater to Land and Space applications utilizes variety of Technologies. It is imperative for all concerned viz designers, manufacturers, users and even media agencies to have due exposure and expertise of these technologies. This Post Graduate course in Defence Technologies (PGDT) provides necessary information and opportunities to excel in the field of Defence Technologies.

SCOPE

This course provides basic information on all major technologies related to Design, Development and Production of Defence equipment. This equipment ranging from Underwater to Land and Space applications utilize variety of Technologies like Armament and Ammunition, Light and Tracked carrier vehicles, Bridges, Structures, Land and Sea Mines, Naval ships, Missile systems, Aerospace Systems, Communication systems, Electronic Warfare, NBC Protection, Special materials, Clothing, Food etc. and Quality assurance & Reliability of all above.

METHOD OF TEACHING

All the sessions will be interactive and participatory in nature. Apart from regular classroom teaching, following pedagogy will be used for this diploma: -

- a) **Guest Lectures.** Guest Lectures will be delivered by the experts in various fields related to defense technology.
- b) **Case Studies.** Students will be encouraged to research / read and discuss the contemporary case studies on defense technology.

CAREER PROSPECTS

On completion of the course, participants will be exposed to all the major technologies employed for the defense equipment. Serving participants shall enhance their professional contribution in their assignments. Non serving candidates will improve their employability and participants at large shall be in a better position to appreciate technological complexities of defense equipment and operations. Media personnel can bring clarity in their technical reporting.

SemesterI

Course No	Course Title	Course Credit	Total Marks
DT 1.1	National Security: Key Concepts	4	100
DT 1.2	Armament, Explosive an Propellant systems	3	75
DT 1.3	Detection and Disposal of Life Expired Explosives, Ammunitions and Mines and Quality Assurance	3	75
DT 1.4	Missile Systems	3	75
DT 1.5	Materials and Miscellaneous	3	75

SemesterII

Course No	Course Title	Course Credit	Total Marks
DT 2.1	Ground/ Land System and Armour Protection Systems	4	100
DT 2.2	Naval and Aerial Systems	4	100
DT 2.3	Communication Systems	4	100
DT 2.4	Research Methodology, Dissertation& Presentation	4	100

Summary

Semester	Credits	Marks
Semester I	16	400
Semester II	16	400
Total	32	800

DT 1.1 National Security: Key Concepts

This is one of the core courses that provide the students an understanding of various dimensions of National Security. In the recent years the National Security issues have caught the attention of scholars all over the world. This has been because of insecurity and instability. As a result, the problems of National Security have acquired a new dimension.

1. Concepts:

- Nation;
- Nationalism
- Nation State
- National Power
- National Security

2. Key Concepts of Security:

- Balance of Power,
- Deterrence, Brinkmanship and Compellence
- Collective Security
- Neutrality,
- Nonalignment,
- Equal Security,
- Common Security,
- Comprehensive Security,
- Human Security.

3. Approaches to Peace:

- Diplomacy,
- International Law,
- United Nations and Pacific Settlement of Disputes
- Arms Control and Disarmament.
- Track II diplomacy

Readings

Mishra K.P. (ed) Foreign Policy of India: A Book of Readings (New Delhi: Thompson(1977)

Prasad Bimal (ed) India's Foreign Policy: Studies in Continuity and Change (New Delhi: Vikas,1979)

Sen Garitam, Haksar P.N. India's Foreign Policy and its Problems ((Delhi: Atlantic, 1993)

Paranjpe Shrikant Parliament and the Making of Indian Foreign Policy: A Study of Nuclear Policy (New Delhi Radiant,1997)

Thakkar Usha and Kulkarni Mahesh India in World Affairs: Towards the 21st Century (Mumbai: Himalaya,1999)

T.D Joseph, Winning India's Next War, (New Delhi: Knowledge Publishers,2008)

Vijay Khare, Dr. B.R Ambedkar and India's national Security) New Delhi. Kilaso,2005)

Journals:

International Studies (New Delhi),

India Quarterly (New Delhi)

Report:

Annual Report of Ministry of External Affairs,

Government of India, New Delhi (Latest available)

DT 1.2 Armament, Explosive and Propellant Systems

The course will give in depth knowledge of explosives, rockets and gun propellants, small arms, pyrotechnics (igniters and fuses). It also covers the selection criteria of explosives for different conventional and missile warheads. The due coverage is also given on explosive safety, testing and evaluation of ammunitions. The following topics will be covered:

1. Rockets

Introduction, classification of gun and rocket propellants, performance parameters of gun and rocket propellants, system configuration and sub systems, functions, design considerations, development testing, quality assurance, safety and life cycle management, life extension studies of propellants/ missiles.

2. Smallarms

Small arms, guns, mortars, mines (land and sea), bombs (aerial), detonators, igniters, fuses, pyrotechnics devices, high energy beam weapon system.

3. Warhead Technology

Definition, warhead classification, warhead types, pre-fragmented, blast, HEAT, HESH and incendiary warheads, runway denial and penetrating warhead. Bomblet, long rod penetrators, shaped charge warhead, fuel-air explosive warhead, thermo baric warhead.

Criteria for Warhead Selection – warhead configuration, warhead Types vis- a – vis design criteria and process, damage and defeat criteria, fundamentals of warhead design, charge to mass ratio, governing formulae for warhead design.

Materials for warhead (type of material, material selection and processing), warhead assembly and integration, warhead development process, warhead test and evaluation, warhead integration with carrier system, integrated system test and evaluation, QA & QC approach and practices, warhead environmental tests, warhead safety standards and practices.

References:

Paul Cooper, (1996), *Introduction to technology of explosives*, MC Graw Hill, NY

J.P Agarwal, (2010), *High energy materials (propellants, Explosives and pyrotechnics)*, Wiley VCH

R. Meyer & J. Kohler, (2007), *Explosives*, Wiley VCH.

Sutton G.P, (2000), *Rocket Propulsion elements, 7th edition*, John Wiley and Sons.

Urbanski T, (1984), *Chemistry and Technology of explosives (volume 1-4)*, Pergamon Press. Oxford. Haridwar Singh & H. Shekhar, (2005), *Science and Technology of solid rocket propellants*, Print well. Safety and accident prevention in chemical operations, (1982), John Wiley and Sons, New York.

DT 1.3 Detection and Disposal of Life Expired Explosives, Ammunitions and Mines and Quality Assurance/ Safety of Ammunitions

The subject covers various conventional and special methods for detection of explosives, propellants and filled ammunitions (live and life expired), underground mines (land and sea). The advanced non-destructive techniques (nuclear techniques and laser techniques) for detections of explosives and propellants are also covered.

1. Detection and Disposal:

- Explosives
- Propellants and filled ammunitions
- Underground land and sea mines

2. Reliability, Quality Assurance, Safety, Maintenance and Handling

- Quality Assurance Plans & Documentation
- Quality Control implementation,
- Testing, Calibration, Evaluation and Analysis
- Simulation and Modelling
- Extreme Climate Worthiness Study
- Field trials under different climatic environments, dynamic & terrain
- Design verification and validation
- Reliability and Statistical Tools

References:

JehudaYinon, (1993), *Advances in Analysis and Detection of Explosives*, Proceedings of the 4th International Symposium on Analysis and Detection of Explosives, September 7–10, 1992, Jerusalem, Israel.

S.G. Kulkarni, (2001), *Detection and analysis of explosives by nuclear technique*, in the proceedings of seminar on nuclear and radio chemistry held at University of Pune, pp 459-460

S.G Kulkarni et al. (2003), *Emerging trends in detection of CB warfare agents, in the proceeding of the seminar on NBCD preparedness as a national imperative*, emerging implication for armed forces, held at INS, Shivaji, Lonavala.

Proceedings of second national workshop of explosives detections, NWED-2020, organised by HEMRL, Pune.

W J Mcgonnagle (Ed.), (1981), *International Advances in non-destructive testing*, Gordon and Breach science and publishers, NY.

Renyan Jiang, *Introduction to Quality and Reliability Engineering*, Springer, Berlin, Heidelberg

JehudaYinon& Shmuel Zitrin, (1981), *The Analysis of Explosives*, Pergamon

B.S. Dhillon, (2019), *Reliability, Quality, and Safety for Engineers*, CRC Press.

DT 1.4 Missile Systems

The subject module covers different types of missiles, missiles launcher, and guidance and control systems of missiles. The following sub topics are covered in depth.

1. Introduction to MissileSystem
2. Missile SystemConfiguration
3. MissileConfiguration
4. Missile Classifications, Types andApplications
5. Missile Basic Sub Systems: Aero-structure, Propulsion, Control, Guidance,Warhead
6. Missile System DesignCriteria
7. Aerodynamic DesignConsiderations
8. Structures Design Principles, Materials andApproach
9. Propulsion Systems: Configurations, Basic Description, Types and Selection, Design Considerations, Materials, System Simulations, Testing, Development, Production, Storage, Maintenance, Life cycle Support, Disposal management, Safety, QA,Challenges.
10. Control Systems, Configuration, Description, Control loop Circuits, Closed and Open Loop Controls, Digital & Analog Control Systems, Pneumatic, Hydraulic, Electrical and Electromechanical Control Actuators, Selection Criteria and Considerations, Materials, QA-QC,Safety
11. Guidance System, Missile System Control and Guidance Loop, Types of Guidance Systems, Guidance Systems Selection- Application- Development- Simulation & Testing, Production, Storage, Maintenance, Calibration, Lifecycle Support and Upgrade,QA_QC
12. Warhead Systems, Classifications & Types, Configuration Details, Selection and Applications, Basic Design Consideration, Development and Production processes, QA_QC, Warhead Testing – Normal to Specialised Methods, Test and Evaluation processes, Integration-Safety-Storage-Maintenance.,Materials
13. BallisticMissiles
14. Anti-Ballistic Missile & Space DefenceSystems
15. Missile Systems Test Criteria and Considerations,Test

In addition to this following **support system** are also included in the module.

- Power Supply – Batteries, Generators, Silentsgenerators
- AirCompressors
- System IntegrationTechnology
- RescueSystems

References:

G.M. Siouris, (2004), *Missile guidance and control systems*, Springer

John H. Blakelock, (1991), *Automatic control of aircraft and missiles*, Wiley.

J. Mattingly & H. von Ohain, (2006), *Elements of propulsion: Gas turbines and rockets*, AIAA Education.

S.S. Chin, (1961), *Missile configuration design*, Mc. Graw Hill Book Company.

G.P Sutton, (2000), *Rocket Propulsion Elements*, 7th edition, Wiley Inter-science.

M. Barrere, (1960), *Rocket propulsion*, Elsevier Publications.

K.Kuo, (2005), *Principle of combustion (2nd edition)*, John Wiley and Sons.

D.E.Carlucci& S.S Jacobson, (2007), *Balistics theory and design of guns and ammunition*, CRC

press. Joseph Carleone, (1993), *Tactical missile warheads*, Volume 155, Progressrs in Astronautical and Aeronautics.

DT.1.5 Materials and Miscellaneous

The subject covers various materials used for various defence systems; it also covers laser, optoelectronics, microwave systems etc. used in defence technology. The following sub topics are included in this subject.

1. Materials – High Strength, High Energy, Composites
2. Materials – Naval and Extreme weather applications
3. Clothing
4. Food
5. Alternate Energy
6. Terrain Research - Snow & Avalanche, Desert
7. Antarctica
8. Life Sciences, Laser Technology, Optics, Electro Optics, Microwaves, Operational Research, Radiations and Camouflage, CBRN warfare Defence, Disaster Management, Solid state physics
9. Night Vision devices
10. Sensors and Actuators
11. Underwater sensors
12. Cyber Security and Warfare
13. Micro Electronic Devices
14. Camouflaging

References:

William D. Callister, *Material Science and engineering*, John Wiley and Sons.

Kumar and S.K Gupta, (1978), *Fundamentals of Polymer science and Engineering*, Tata Mc Graw-Hill. Somai S.M, (1992), *Chemical warfare agents*.

Joshua Lederberg, (1999), *Biological weapons*.

R.F Taylor, Jerome S. Schultz, (1996), *Handbook of chemical and biological sensors*, CRC Press. Gandhi M.V & Thompson, B. S, (1992), *Smart materials and structure*, Chapman and Hall. William D. Callister, *Material science and engineering: An Introduction*, 6th Edition, Wiley.

D. Patranabis, (2013), *Sensors and transducers, 2nd edition*, PHI Publications.

SEMESTER II

DT 2.1 Ground Systems and Armour Protection Systems

Various ground (lands) systems are covered in depth in this module. The different types of armours systems (for body, vehicle, tank armour) including the recent developments in armour technology are adequately included in the module. The following sub topics are included:

1. Bridges: - Classification, Design criteria, materials, manually assembled, mechanically launched.
2. Structures:- Classification, Design criteria, Materials, Quick erectable
3. Vehicles, Light
4. Combat /Armoured
5. Masts (Pedestal) for Radars
6. Robotics

Reference:

Phillip McKerrow, (1991), *Introduction to robotics*, Addison Wesley.

R Zaera, (2011), *Ballistic Impacts on polymer Matrix composites-Composite Armour, Personal Armour*, Vienna ISBN, 0978-3709105221

Andrew Wereszczak & Edger Lara Curzio, (2006), *Advances in ceramic Armour II, Ceramic engineering and science proceedings*, Wiley ISBN 0978-0470080573

Christopher F Foss, (2011-12), *Jane's Armor and artillery*, HIS JAnes, ISBN 0978-0710629609 Payton Z. Peebles, *Radar principles*, Wiley.

DT 2.2 Naval and Aerial Systems

The different naval systems including naval warheads are covered in the module. The aerial systems including different types of aircrafts are covered in this module. The emergency escape system are also has been given due coverage.

1. NavalSystem

- Ships
- Submarines
- Torpedos
- Sonarsystems
- Underwater Autonomousvehicles

2. AerialSystem

- FighterAircrafts
- TransportAircrafts
- Helicopters
- TrainerSimulators
- Remotely Piloted Vehicle (RPV/ UAV /Drones)

3. Escape system Emergency

- Aircraft Escape System –Definition & Description (CSS and propellants for seatejection)
- Types of EscapeSystem
- Ground Escapesystem
- Air ScapeSystem
- Basic DesignConcept
- Safety
- Development, Production, Quality Assurance, Testing, Packing,Forwarding.

References:

- Lillesand and Kiefer, (2007), *Remote sensing and image interpretation*, John Wiley and Sons. Reg. Austin, (2010), *Unmanned aircraft systems*, Wiley Publications.
- John Anderson Jr., (2014), *Aircraft performance and design*, Mc Graw Hill.
- Kanchan Biswas, (2019), *Military Aviation Principles*, military engineering edited by George Dekoulis.
- T.C Gilmer, (1982), *Introduction to naval architecture*, Naval InstitutePress.
- Rawson and Tupper & Saint Louis, (1994), *Basic Ship Theory, Vol I & II*, Butterworth Heineman.

DT 2.3 Communication Systems

The communication systems are included in the subject. The various sub topics covered are as follows:

1. Wired Communication Systems
2. Radars, AWACS
3. Fire control Computer communication
4. Satellite Communication
5. Telemetry, Tele command and Data Acquisition & Display system
6. Under water communication systems

References:

John G. Proakis Masoud Salehi, (2008), *Digital communication*, 5th Edition Mc Graw, Hill.

Herbert Taub & Donald L. Schilling, (2008), *Principals of communications system*, 3rd Edition Mc Graw, Hill. John & Steve Mackay, (2003), *Practical data acquisition for instrumentation and control*, Newness Publication.

Payton Z. Peebles, *Radar principles*, Wiley.

Dennis Roddy, (2001), *Satellite communications*, 3rd edition Mc Graw Hill Publications.

Timothy Pratt, Charles Bostin & Jerry Allnutt, (2003), *Satellite communication*, 2nd edition, Wiley Publications.

Shengli Zhou & Zhohui Wang, (2014), *Underwater Acoustic Communication*, John Wiley and Sons.

Adnane Addaim, Abdelhak Kherras & El Bachir Zantou, (2007), *Design of a Telecommand and Telemetry System for use on Board a Nanosatellite*, 14th IEEE International Conference on Electronics, Circuits and Systems.

DT2.4 Research Methodology, Dissertation and Presentation

Dissertation: -Students are advised to select their topic in consultation with their guide. Dissertation will be evaluated by expert in concern field and marks will be given by the quality of research work. Dissertation cannot be published in the form of book or research paper without the permission from competent authority. It will be the copy right and property of Department of Defence and Strategic Studies and University of Pune and IDST.

Part I

- This is for Internal Assessment of 30 marks
- This introduces the students to various tools and approaches used in social sciences and the formulation of a Research Framework.
 1. Nature of Social Sciences and Research
 2. Recent trends in Social Science Research
 3. Descriptive and Historical Methods
 4. Scientific Approaches
 5. Planning a research Project.

Part II

- Students are advised to select their topic in consultation with their guide.
- The research paper is a longish research essay of publishable quality (of about 30 to 40 pages /approx. 10,000 words).

Format of Submission: -

- a) Students are required to submit TWO Copies of the dissertation, duly typed and bound.
- b) Use A4 size paper and use Times New Roman script with 12 font size and one and a half spacing for lines.

Evaluation: -

1. The evaluation shall be done by the Internal Examiner (Guide) and one External Examiner from within the Department or the Post Graduate Centre. (Evaluation done in a combined manner for 50 marks)
 2. Students would have to make a seminar presentation in the Department or the Post Graduate Centre. (Evaluation done by the Guide and the External Examiner who evaluates the written report in a combined manner for 20 marks)
 3. Evaluation: Research Methodology: 30 marks/Paper 50 Marks/Seminar 20 Marks – Total: 100 marks.
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