# Faculty of Science and Technology
# Savitribai Phule Pune University
# Maharashtra, India


# Honors* in major Disciplines Board of Studies
# (Electronics & Telecommunication)
# (2019 Course)
**(with effect from A.Y. 2021-22)**

# Savitribai Phule Pune University
## Board of Studies (Electronics & Telecommunication)
## With effect from 2021-22

# Honors* in Robotics

| Course Code | Course Title | Teaching Scheme Hours / Week | | | Examination Scheme and Marks | | | | | | Credit Scheme | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Theory | Tutorial | Practical | Mid-Semester | End-Semester | Term work | Practical | Presentation | Total Marks | Theory / Tutorial | Practical | Total Credit |
| **304181 HR** | Principles of Robotics | 04 | -- | -- | 30 | 70 | -- | -- | -- | 100 | 04 | -- | 04 |
| **304182 HR** | Principles of Robotics Laboratory | -- | -- | 02 | -- | -- | 50 | -- | -- | 50 | -- | 01 | 01 |
| | Total | 04 | - | 02 | 100 | | 50 | - | - | 150 | 04 | 01 | 05 |
| | | | | | | | | | **Total Credits =** | | **05** | | |
| **304183 HR** | Robot Programming & Simulation | 04 | -- | -- | 30 | 70 | -- | -- | -- | 100 | 04 | -- | 04 |
| | **Total** | 04 | - | - | 100 | | - | - | - | 100 | 04 | - | 04 |
| | | | | | | | | | **Total Credits =** | | **04** | | |
| **404181 HR** | Industrial Robotics & Automation | 04 | -- | -- | 30 | 70 | -- | -- | -- | 100 | 04 | -- | 04 |
| **404182 HR** | Industrial Robotics & Automation Laboratory | -- | -- | 02 | -- | -- | 50 | -- | -- | 50 | -- | 01 | 01 |
| | **Total** | 04 | - | 02 | 100 | | 50 | - | - | 150 | 04 | 01 | 05 |
| | | | | | | | | | **Total Credits =** | | **05** | | |
| **404183 HR** | Artificial Intelligence in Robotics | 04 | - | -- | 30 | 70 | -- | -- | -- | 100 | 04 | -- | 04 |
| **404184 HR** | Seminar | -- | 02 | -- | -- | -- | - | -- | 50 | 50 | 02 | -- | 02 |
| | **Total** | 04 | - | 02 | 100 | | - | -- | 50 | 150 | 06 | - | 06 |
| | | | | | | | | | **Total Credits =** | | **06** | | |

**Total Credit for Semester V+VI+VII+VIII = 20**

*** To be offered as Honors for Major Disciplines as–**

1. **Electronics Engineering**
2. **Electronics and Telecommunication Engineering**
3. **Electronics & Computer Engineering**
4. **Mechanical Engineering**

**For any other Major Disciplines which is not mentioned above, it may be offered as Minor Degree.**

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**304181 HR: Principles of Robotics**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Theory: 04 Hours / Week | 04 | In-Sem (Theory): 30 Marks<br>End Sem (Theory): 70 Marks |

## Course Contents

| Unit I | Fundamentals of Robotics | (08 Hrs) |
|---|---|---|

Historical development of Robotics, Definitions of Industrial Robot, Type and Classification of Robots, Asimov's laws of robotics, Robot configurations, Robot Components, Robot Degrees of Freedom, Work volume and work envelope, Robot Joints and symbols, Robot Coordinates, Robot Reference Frames, Resolution, accuracy and precision of Robot, Work cell control

| Unit II | Robot Drive systems | (08 Hrs) |
|---|---|---|

Pneumatic Drives, Hydraulic Drives, Mechanical Drives, Electrical Drives-D.C. Servo Motors, Stepper Motors, A.C. Servo Motors, BLDC-Salient Features, Applications and Comparison of all these Drives, Micro actuators, selection of drive, Power transmission systems for robot, Motion conversion, Determination of HP of motor, Types of Gearbox: - Planetary, Harmonic, Cycloidal gearbox and gear Ratio, variable speed arrangements

| Unit III | End Effectors | (08 Hrs) |
|---|---|---|

Grippers, Mechanical Grippers, Pneumatic and Hydraulic- Grippers, Magnetic Grippers, Vacuum Grippers; Two Fingered and Three Fingered Grippers; Internal Grippers and External Grippers; Advance Grippers- Adaptive grippers, Soft Robotics Grippers, Tactile Sensor Grippers; Various process tools as end effectors; Robot end effectors interface, Active and passive compliance, Selection and Design Considerations.

| Unit IV | Robot Sensors | (06 Hrs) |
|---|---|---|

Transducers and sensors, Sensors in robotics, Principles and applications of the following types of sensors- Proximity Sensors, Photo Electric Sensors, Laser Scanners, Position sensors – Piezo Electric Sensor, LVDT, Resolvers.

**Encoders:** Absolute and Incremental: - Optical, Magnetic, Capacitive, pneumatic Position Sensors

**Range Sensors:** Range Finders, Laser Range Meters, Touch Sensors, Force and torque sensors.

**Safety Sensor:** Light Curtain, Laser Area Scanner, Safety Switches; Machine vision

| Unit V | Mathematical Modelling of Robot | (08 Hrs) |
|---|---|---|
| Direct Kinematics, Co-ordinate and vector transformation using matrices, Rotation matrix, Inverse Transformations, Composite Rotation matrix, Homogenous Transformations, Robotic Manipulator Joint Co-ordinate System, inverse kinematics of two joints, DH Parameters, Jacobian Transformation in Robotic Manipulation | | |
| | | |
| **Unit VI** | **Role of Microcontroller in Robotics** | **(08 Hrs)** |
| Pick and place Robot, Application of Robots in Arc Welding Robots, Assembly and mega-assembly Robots continuous arc welding, Spot welding, Spray painting, assembly operation.<br><br>**Robots for Inspection:** Robotic vision systems, image representation, object recognition and categorization, depth measurement.<br><br>**Other industrial applications:** Coating, Deburring, cleaning, Die Casting, Moulding, Material handling, Picking, Palletizing, Packaging, hospitals and patient care, F&B industry, sports and recreation, defense and surveillance industry, home automation, mining industry.<br><br>A robot-based manufacturing system, robot cell design considerations and selection of robot, Robot Economics, Functional Safety in Robotic Application | | |
| | | |

## Learning Resources

### Text Books:


1. M.P. Groover , "Automation, Production Systems & Computer Integrated Manufacturing", PHI, 3rd Edition, 2012.
2. M.P. Groover, M.Naegel, "Industrial Robotics, Technology, Programming & Applications", TMH,2nd Edition, 2012.


### Reference Books:


1. J.G. Keramas, "Robotics Technology Fundamentals", Thompson Learning, 2nd Edition, 2002.
2. J.J.Craig "Introduction to Robotics Mechanics & Control", Pearson Education, 3rd Edition,2004.
3. Fu. K. S., Gonzalez. R. C. & Lee C.S.G., "Robotics Control, Sensing, Vision and Intelligence", McGraw Hill Book co, 1987.
4. S.R. Deb, " Robotics Technology and Flexible Automation", TMH, 2nd Edition, 2010.
5. Mike Wilson, "Implementation of Robotic Systems"

## MOOC / NPTEL Courses:

**1.** NPTEL Course on **"Robotics"**

https://nptel.ac.in/courses/112/105/112105249/

**2.** NPTEL Course on **"Introduction to Robotics"**

https://nptel.ac.in/courses/107/106/107106090/

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**304182 HR: Principles of Robotics Lab**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Practical: 02 Hours / Week | 01 | Practical: 50 Marks |

## Guidelines for Laboratory Conduction

During each lab experiment the following activities will be carried out:

- The instructor will explain the aims & objectives of the assignments.
- The instructor will explain the topics required to carry out the experiment.
- The students will do the hands on as per the Lab manual & Web resources provided.
- The students will show the results to the instructor.

## Guidelines for Student's Lab Journal

The student's Lab Journal can be assignments submitted in the form a soft copy/hard copy. In case of soft copy submission, the print out of only first page can be kept in the Journal. It should include following as applicable:

Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

## Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

## List of Laboratory Experiments

| | |
|---|---|
| 1. | Identify and selection of Sensors such as IR sensors, Proximity Sensor, Ultrasonic Sensor, White line sensor, Temperature Sensor, Touch sensor, Tilt Sensor, Accelerometer, Gyroscopic Sensor etc. based on given application |
| 2. | Identify and selection of Actuators and related hardware such as DC motor, Servo motor, Stepper Motor, Motor drivers based on applicatio |
| 3. | Demonstration of various robotic configurations using industrial robot |
| 4. | Design and selection of Gripper / End effector |
| 5. | One Programming exercise on lead through programming |

| | |
|---|---|
| 6. | MATLAB program for simple and inverse kinematics of simple robot configuration |
| 7. | To demonstrate simple robotic system using Matlab/ MscAdam / RoboAnalyser software |
| 8. | One Industrial visit for Industrial robotic application |

## Virtual LAB Links:

1. **Mechanisms & Robotics Lab**

   http://vlabs.iitkgp.ernet.in/mr/

2. **Robotics Application Lab**

   https://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525

3. **Bio Inspired Robotics Virtual Lab**

   https://vlab.amrita.edu/?sub=3&brch=257

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**304183 HR: Robot Programming & Simulation**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Theory: 04 Hours / Week | 04 | In-Sem (Theory): 30 Marks<br>End Sem (Theory): 70 Marks |

## Course Contents

| Unit I | Robot Operating Systems | (08 Hrs) |
|---|---|---|

Introduction –The ROS Equation, History, Distributions & difference from other meta-operating systems. ROS framework: Operating system and its various releases.

| Unit II | Robot Programming | (08 Hrs) |
|---|---|---|

Introduction to Robotic Programming, On-line and off-line programming, programming examples. Various Teaching Methods, Survey of Robot Level Programming Languages, A Robot Program as a Path in Space, Motion Interpolation, various Textual Robot Languages, Typical Programming Examples such as Palletizing, Loading a Machine, etc.

| Unit III | Robot Langauge: VAL Language | (08 Hrs) |
|---|---|---|

Classifications, Structures- VAL language commands motion control, hand control, program control, pick and place applications, palletizing applications using VAL, Robot welding application using VAL program-WAIT, SIGNAL and DELAY command for communications using simple applications. VAL-II programming-basic commands, applications- Simple problem using conditional statements-Simple pick and place applications-Production rate calculations using robot.

| Unit IV | Robot Langauge: RAPID Language | (07 Hrs) |
|---|---|---|

Motion Instructions-Pick and place operation using Industrial robot- manual mode, automatic mode, and subroutine command based programming. Move master command language- Introduction, syntax, simple problems. AML Language-General description, elements and functions, Statements, constants and variables-Program control statements-Operating systems, Motion, Sensor commands-Data processing.

| Unit V | Virtual Robot System | (08 Hrs) |
|---|---|---|
| Introduction to soft robotics; Robotic Process Automation (RPA); Computer Vision, AR & VR in Robotics.<br>Multiple robot and machine Interference-Process chart-Simple problems-Virtual robotics, Robot studio online software- Introduction, Jogging, components, work planning, program modules, input and output signals-Singularities-Collision detection-Repeatability measurement of robot-Robot economics. | | |
| | | |
| **Unit VI** | **System Simulation** | **(08 Hrs)** |
| Basics of simulation, Steps in simulation, Discrete event system simulation, Advantages and disadvantages of simulation, Decision making with simulation.<br>Techniques of simulation, Monte Carlo method, Experimental nature of simulation, Distributed lag models, Cobweb models Continuous system models, Analog and Hybrid simulation, Feedback systems,<br>Computers in simulation studies. Simulation software: Comparison of simulation packages with programming languages, classification of simulation software, Description of a general purpose simulation package,<br>Design of scenario and modules, dialog box, database, animation, plots and output, interfacing with other software, summary of results. Examples with MATLAB/ AWESIM / ARENA. | | |
| | | |

## Learning Resources

### Text Books:


**1.** Lentin Joseph, "Robot Operating Systems (ROS) for Absolute Beginners, A press, 2018


### Reference Books:


**1.** Jason M O'Kane, "A Gentle Introduction to ROS", CreateSpace, 2013.

**2.** AnisKoubaa, "Robot Operating System (ROS) – The Complete Reference (Vol.3), Springer, 2018.

**3.** Kumar Bipin, "Robot Operating System Cookbook", Packt Publishing, 2018.

**4.** Wyatt Newman, "A Systematic Approach to learning Robot Programming with ROS", CRC Press, 2017.

**5.** Patrick Gabriel, "ROS by Example: A do it yourself guide to Robot Operating System", Lulu, 2012.

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**404181 HR: Industrial Robotics & Automation**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Theory: 04 Hours / Week | 04 | In-Sem (Theory): 30 Marks<br>End Sem (Theory): 70 Marks |

## Course Contents

| Unit I | Fundamentals of Industrial Automation | (08 Hrs) |
|---|---|---|

Fundamental concepts in manufacturing and automation, definition of automation, reasons for automating. Types of production and types of automation, automation strategies, levels of automation.

| Unit II | Transfer Line & Automated Assembly | (08 Hrs) |
|---|---|---|

General terminology and analysis, analysis of transfer lines without storage, partial automation. Automated flow lines with storage buffers. Automated assembly-design for automated assembly, types of automated assembly systems, part feeding devices, analysis of multi-station assembly machines. AS/RS, RFID system,

| Unit III | Pneumatic Control | (08 Hrs) |
|---|---|---|

Components, constructional details, filter, lubricator, regulator, constructional features, types of cylinders, control valves for direction, pressure and flow, air motors, air hydraulic equipment.

**Pneumatic Control System Design:** General approach to control system design, symbols and drawings, schematic layout, travel step diagram, circuit, control modes, program control, sequence control, cascade method, Karnaugh -Veitch mapping

| Unit IV | Programmable Automation | (05 Hrs) |
|---|---|---|

Special design features of CNC systems and features for lathes and machining centers. Drive system for CNC machine tools. Introduction to CIM; condition monitoring of manufacturing systems.

**Design for high speed automation assembly:** Introduction, Design of parts for high speed feeding and orienting, high speed automatic insertion. Analysis of an assembly. General rules for product design for automation.

| Unit V | Design of Mechatronics Systems | (08 Hrs) |
|---|---|---|
| Stages in design, traditional and mechatronic design, possible design solutions. Case studies-pick and place robot, engine management system | | |
| | | |
| **Unit VI** | **Elements of Hydraulic systems** | **(05 Hrs)** |
| Pumps and motors- types, characteristics. Cylinders, types, typical construction details. Valves for control of direction, flow and pressure, types, typical construction details.<br><br>**Hydraulic System Design:** Power pack–elements, design. Pipes material, pipe fittings. Seals and packing. Maintenance of hydraulic systems. Selection criteria for cylinders, valves, pipes. Heat generation in hydraulic system.<br><br>**Advanced topics in Hydraulics and Pneumatics:** Electro pneumatics, ladder diagram. Servo and Proportional valves - types, operation, application. Hydro-Mechanical servo systems. PLC- construction, types, operation, programming | | |
| | | |

## Learning Resources

### Text Books:


**1.** Todd D.J., "Fundamentals of Robot Technology", Wiley Publications,

**2.** Groover M.P., Weiss M., Nagel R.N., Odrey N.G., "Industrial Robotics Technology – Programming and Applications", McGraw Hill Book Co.

**3.** Fu K.S., Gonzalex R.C., Lee C.S.G., "Robotics Control Sensing, Vision and intelligence", McGraw Hill Book Co.

**4.** W. Bolton, "Mechatronics", Pearson Education


### Reference Books:


**1.** M.P. Groover, "Industrial Robots – Technology Programmes and Applications", McGraw Hill

**2.** Heinrich H W, Industrial Accident Prevention, National Safety Council, Chicago

**3.** Accident Prevention Manual for Industrial Operations, National Safety Council, Chicago.

**4.** "Personal Protective Equipment", National Safety Council, Bombay.

**5.** W. Deppert, K.Stoll, "Pneumatic Application"

**6.** S.F. Krar**, "**Computer Numerical Control Simplified", Industrial Press, 2001


### MOOC / NPTEL Courses:

**1.** NPTEL Course on **"Robotics"**

https://nptel.ac.in/courses/112/105/112105249/

**2.** NPTEL Course on **"Introduction to Robotics"**

https://nptel.ac.in/courses/107/106/107106090/

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**404182 HR: Industrial Robotics & Automation Lab**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Practical: 02 hrs. / week | 01 | Practical: 50 Marks |

## Guidelines for Laboratory Conduction

During each lab experiment the following activities will be carried out:

- The instructor will explain the aims & objectives of the assignments.
- The instructor will explain the topics required to carry out the experiment.
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The student's Lab Journal can be assignments submitted in the form a soft copy/hard copy. In case of soft copy submission, the print out of only first page can be kept in the Journal. It should include following as applicable:

Assignment No, Title of Assignment, Date of Performance, Date of Submission, Aims & Objectives, Theory, Description of data used, Results, Conclusion.

## Guidelines for Lab /TW Assessment

The oral examination will be based on the work carried out by the student in the Lab course. Suitable rubrics can be used by the internal & external examiner for assessment.

## List of Laboratory Experiments

| | |
|---|---|
| 1. | Study of configuration of robots and motion of robot manipulator |
| 2. | Study of pick and place industrial robot |
| 3. | Study and analysis of robot grippers (includes the problems based on gripper force) |
| 4. | To perform preventive maintenance – checklist & schedule of pick & place robot. |
| 5. | To perform risk assessment for robot. |
| 6. | To calculate safe distance of operational robot. |

| | |
|---|---|
| 7. | Case Study on advanced industrial applications of robots |
| 8 | Assignment on safety standards for industrial robot. |

## Virtual LAB Links:

1. **Mechanisms & Robotics Lab**

   http://vlabs.iitkgp.ernet.in/mr/

2. **Robotics Application Lab**

   https://vlab.amrita.edu/?sub=3&brch=271&sim=1642&cnt=3525

3. **Bio Inspired Robotics Virtual Lab**

   https://vlab.amrita.edu/?sub=3&brch=257

| Savitribai Phule Pune University<br>Board of Studies (Electronics & Telecommunication)<br>Honors in Robotics<br>404183 HR: Artificial Intelligence in Robotics | | |
|---|---|---|
| **Teaching Scheme:** | **Credit** | **Examination Scheme:** |
| **Theory: 04 hrs. / week** | **04** | **In-Sem (Theory): 30 Marks**<br>**End Sem (Theory): 70 Marks** |

## Course Contents

| Unit I | Introduction to artificial intelligent techniques | (08 Hrs) |
|---|---|---|

Goals of AI in manufacturing, tools for AI such as Search algorithm, Mathematical optimization, Evolutionary computation, fuzzy logic, Probabilistic methods for uncertain reasoning such as Bayesian network, Hidden Markov model, Kalman filter, Decision theory and Utility theory, statistical learning methods, support vector machines, neural networks, expert systems

| Unit II | Handling uncertainty and Learning | (10 Hrs) |
|---|---|---|

Non-monotonic reasoning, probabilistic reasoning, use of certainty factors, fuzzy logic, Concept of learning, learning automation, genetic algorithm, learning by inductions, neural network, Unsupervised learning- K-Means clustering, Boltzmann machine, Supervised learning-classification algorithms, support vector machine.

| Unit III | Search Algorithms in AI | (08 Hrs) |
|---|---|---|

Algorithms for uninformed and informed search, Heuristics search: hill climbing, branch and bound, best first search, Metaheuristics: Simulated annealing, Tabu search, ant colony optimization, real coded genetic algorithm.

| Unit IV | Machine Vision in Robotics | (06 Hrs) |
|---|---|---|

Machine vision algorithms, Imaging based automatic sorting and inspection, image processing, imaging based robot guidance,

| Unit V | Intelligent Robotics Systems | (08 Hrs) |
|---|---|---|
| Applications of intelligent systems for mobile Robot Motion Planning, Path Planning Robot Control in Dynamic Environments, Task Based Hybrid Closure Grasping Optimization for Autonomous Robot Hand. Accurate Motion Control of Fast Mobile Robots, obstacle avoidance. | | |
| | | |
| **Unit VI** | **Artificial Intelligence in Flexible Automation** | **(08 Hrs)** |
| Applications of various intelligent systems for FMS functional segmentation schemes including control, real time scheduling, tool management, process planning, route optimization for AS/RS systems. | | |
| | | |

## Learning Resources

### Text Books:

**1.** Steger, Carsten, Markus Ulrich, Christian Wiedemann, "Machine Vision Algorithms and Applications",2nd Ed. Wiley, 2018.

**2.** Jain N, "Artificial Intelligence: making a system intelligent", 2018

### Reference Books:

**1.** Mikell P Groover, Automation, Production System and Computer Integrated Manufacturing, Prentice Hall, Publications, 2016. ISBN 9789332549814

**2.** Bhattacharya S., "Artificial Intelligence", Laxmi Publications, Ltd., 2008

**3.** Chopra Rajiv, "Artificial Intelligence", S. Chand Publishing, 2012

### MOOC / NPTEL Courses:

**1.** NPTEL Course on **"Robotics"**
https://nptel.ac.in/courses/112/105/112105249/

**2.** NPTEL Course on **"Introduction to Robotics"**
https://nptel.ac.in/courses/107/106/107106090/

**3.** NPTEL Course on **"Artificial Intelligence"**
https://nptel.ac.in/courses/106/105/106105077/

**4.** NPTEL Course on **"An Introduction to Artificial Intelligence"**
https://nptel.ac.in/courses/106/102/106102220/

**Savitribai Phule Pune University**

**Board of Studies (Electronics & Telecommunication)**

**Honors in Robotics**

**404184 HR: Seminar**

| Teaching Scheme: | Credit | Examination Scheme: |
|---|---|---|
| Tutorial: 02 Hrs. / Week | 02 | Presentation: 50 Marks |

Seminar is a course requirement where in under the guidance of a faculty member a student is expected to do an in depth study on the topic relevant to latest trends in the field of concerned Honors degree selected by him / her and approved by the authority; by doing literature survey, understanding different aspects of the problem and arriving at a status report in that area. While doing a seminar, the student is expected to learn investigation methodologies, study relevant research papers, correlate work of various authors/researchers critically, study concepts, techniques, prevailing results etc., analyze it and present a seminar report. It is mandatory to give a seminar presentation before a panel constituted for the purpose. The grading is done on the basis of the depth of the work done, understanding of the problem, report and presentation by the student concerned.

## GUIDELINES FOR THE SEMINAR

### A. Guidelines for preparation of Report:

- Report should have at least 30 and at most 50 pages.
- The entire pages of the report should be in A4 size strictly, with 1" top and bottom margin and 1.25" left and right margin.
- The entire report should be typed in Times New Roman with **(12 Pt.)**
- The title and main headings of the paragraphs are to be in bold.
- Report may be divided into the number of chapters as required, with chapter number assigned on the top left corner and chapter name immediately below it (with single line spacing) using Times New Roman **(16 Pt. Bold).**
- Every sub heading should be given decimal of whole number of the heading. (e.g1.1).
- The complete text should be justified in the report (no left or right aligning).
- No short forms are to be used in the report besides the specified areas.
- Numbering of each figure and table should be done according to the chapter number.
- Numbering of each page should be done in the footer section at the bottom right corner.
- Each line should be separated by a line spacing of 1.5, and each paragraph by line spacing of 2.

**B. List of Contents in the Report:**

- The Cover
- Cover page. (Same as The Cover)
- Certificate from Department
- Acknowledgement.
- Abstract.
- Table of content.
- List of figures and tables
- The report.
- References and appendices.

**C. Guidelines for Presentation:**

- The presentation shall be limited to 15 minutes plus 10 minutes questions and answers. There will be credit for the novelty of the topic, contents of the seminar, the effectiveness of presentation, and the way questions and queries are answered.
- Presentations shall be prepared using presentation software like MS PowerPoint. If necessary, use charts, drawings, etc.
- Write only points on the slides (use telegraphic language instead of long sentences). The slides shall NOT be a copy of the text of one's seminar report. Ideally 6 to 8 lines only shall be there on each slide.
- Equations shall be given in the final form only. Derivations shall be avoided on slides. However, the derivations can be prepared as separate slides with links from the main presentation so that the same can be used if need arises.
- Use colors to make the slides attractive and to highlight the important points. However, remember that the use of too many different colors can make the slides ugly.
- Choose the letter sizes corresponding to the importance of the points. Use bold/italics type or different colors to stress words or sentences of importance.
- Ensure that all the material presented on slides is legible when projected.
- Reading of the written/typed material or from the slides is not acceptable.