Path Integral and functional methods in quantum field theory

Path integral method is an important formal development in quantum mechanics. The first half of the course should be useful for any student of quantum mechanics, providing deeper insights into the theory. The second half of the course discusses path integral method in its functional form applied to space-time fields and brings out connection of quantised fields to elementary particles.

Quantum theory is increasingly a part of many practical developments, from materials science and nanotechnology to quantum computation. Deeper insights and exposure to novel computational approaches in it will be of use to a wide audience. Specifically within theories of elementary particles, a grasp of this method is a stepping stone to more advanced topics such as String Theory.

INTENDED AUDIENCE: Students of final year of B.Sc. (Physics/Mathematics), final year of B.Tech, M.Sc and PhD students.

PREREQUISITES: Relativistic Quantum Mechanics and free scalar field quantisation

Prof. Urjit A. Yajnik is Faculty at IIT Bombay since 1989. Primary research interest in Elementary Particle Physics and Cosmology. Primary teaching interest mathematical and theoretical physics. I like to design instructional material so that the essentials of the advanced material become accessible to interested undergraduates.

COURSE TYPE

Core

COURSE LEVEL

Postgraduate

COURSE LAYOUT

Week 1: Quantum Theory Fundamental Quantisation and Path Integral Formulation.
Week 2: Path Integral Formulation and Correlation Functions.
Week 3: Generating Functional, Forced Harmonic Oscillator and Generating Function in Field Theory.
Week 4: Effective Potential.
Week 5: Asymptotic Theory, Asymptotic Condition Kallen-Lehmann Representation.
Week 6: Gauge Invariance.
Week 7: Yang Mills Theory and Yang Mills Theory Constraint Dynamics.
Week 8: Gauge Fixing and Faddeev Popov Ghosts and Vacuum topology of Yang-mills Theories.

BOOKS AND REFERENCES

1. P. Ramond, “Field Theory : A Modern Primer”, 2nd Ed.
2. C. Itzykson and J-B Zuber, “Quantum Field Theory”
3. S. Weinberg “Quantum Field Theory - vol. I Foundations”
4. M. Pesking and D. V. Schoeder, “Quantum Field Theory”
5. V. Parameswaran Nair, “Quantum Field Theory : A modern perspective”

CERTIFICATE

- The course is free to enroll and learn from. But if you want a certificate, you have to register and write the proctored exam conducted by us in person at any of the designated exam centres.
- The exam is optional for a fee of Rs 1000/- (Rupees one thousand only).
- **Date and Time of Exams: 29 September 2019**, Morning session 9am to 12 noon; Afternoon Session 2pm to 5pm.
- Registration url: Announcements will be made when the registration form is open for registrations.
- The online registration form has to be filled and the certification exam fee needs to be paid. More details will be made available when the exam registration form is published. If there are any changes, it will be mentioned then.
- Please check the form for more details on the cities where the exams will be held, the conditions you agree to when you fill the form etc.

CRITERIA TO GET A CERTIFICATE

- Average assignment score = 25% of average of best 6 assignments out of the total 8 assignments given in the course.
- Exam score = 75% of the proctored certification exam score out of 100
- Final score = Average assignment score + Exam score

YOU WILL BE ELIGIBLE FOR A CERTIFICATE ONLY IF AVERAGE ASSIGNMENT SCORE >=10/25 AND EXAM SCORE >= 30/75.

- If one of the 2 criteria is not met, you will not get the certificate even if the Final score >= 40/100.
- Certificate will have your name, photograph and the score in the final exam with the breakup.It will have the logos of NPTEL and IIT Bombay. It will be e-verifiable at nptel.ac.in/noc.
- Only the e-certificate will be made available. Hard copies are being discontinued from July 2019 semester and will not be dispatched