ACADEMIC AFFAIRS OFFICE
INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

No. Acd./123 /IAPC-95 Dated: December 16 , 2020

Head, Department of Mathematics

The IAPC in its 95th meeting held on 09.12.2020 and 11.12.2020 vide Item No. 95.3.2 considered and approved the recommendation of DFC of Department of Mathematics to introduce PEC i.e., MAN-658: Operator Theory for the students of M.Sc. and Ph.D.

The approved syllabus is attached as **Appendix-A**.

Assistant Registrar (Curriculum)

Encl: as above

Copy to (through e mail):-

1. All faculty
2. All Heads of Departments/ Centres
3. Dean, Academic Affairs
4. Associate Dean of Academic Affairs (Curriculum)
5. Channel I/ Academic webpage of iitr.ac.in

INDIAN INSTITUTE OF TECHNOLOGY ROORKEE

NAME OF DEPARTMENT/CENTRE: Department of Mathematics

1. **Subject Code:** MAN-658 **Course Title:** Operator Theory
2. **Contact Hours:** **L:** 3 **T:** 0 **P:** 0
3. **Examination Duration (Hrs.):** **Theory:** 3 **Practical:** 0
4. **Relative Weightage:** **CWS:** 20-35 **PRS:** 0 **MTE:** 20-30 **ETE:** 40-50 **PRE:** 0
5. **Credits:** 3 **6. Semester:** Both **7. Subject Area:** PEC
8. **Pre-requisite:** Basic knowledge of functional analysis
9. **Objective:** To provide the knowledge of various operators on Hilbert spaces, their structure and also to study some Hilbert spaces of analytic functions.

10. Details of the Course

S.No.	Contents	Contact hours
1.	Review of Banach spaces, geometry of Hilbert spaces, Riesz Representation Theorem.	3
2.	Operators on Hilbert spaces, self adjoint, normal and unitary operators, isometries, partial isometries, multiplication operators, positive operators, finite rank operators, compact operators and their properties.	8
3.	Eigen spectrum, approximate eigen spectrum, spectrum and resolvent set, numerical range, numerical radius, spectral radius, spectral mapping theorem.	6
4.	Polar decomposition theorem, spectral theorem and singular value representation of a compact self-adjoint operator, minimax principle, trace class operators, Hilbert-Schmidt operators.	7
5.	Spectral measure, spectral integrals, spectral subspaces, spectral theorem for bounded self-adjoint and normal operators.	9
6.	Reproducing Kernel Hilbert Spaces, Hardy space, Dirichlet space, Bergman space, Shift invariant subspaces, Beurling's theorem.	9
Total		**42**

11. Suggested Books:

S.No.	Name of Authors/Book/Publisher	Year of Publication / Reprint
1.	John B. Conway, "A Course in Functional Analysis, 2nd edition", Springer-Verlag, New York	1990
2.	Ronald G. Douglas, "Banach Algebra Techniques in Operator Theory, 2nd edition", Springer- Verlag, New York	1998
3.	V. S. Sunder, "Operators on Hilbert Space", Hindustan Book Agency, New Delhi	2015

4.	V. I. Paulsen, M. Raghupathi, "An Introduction to the Theory of Reproducing Kernel Hilbert Spaces", Cambridge University Press, Cambridge	2016
5.	Paul R. Halmos, "Introduction to Hilbert space and the Theory of Spectral Multiplicity. Reprint of the 2nd (1957) edition", AMS Chelsea Publishing, Providence, RI	1998
6.	K. R. Parthasarathy, "An Introduction to Quantum Stochastic Calculus. Monographs in Mathematics, 85", Birkhäuser Verlag, Basel	1992