1.3.2 Number of value-added courses for imparting transferable and life skills offered during last five

1.3.3 Average Percentage of students enrolled in the courses under 1.3.2 above (10)

Year -1						
Name of the value added courses (with 30 or more contact hours)offered	Course Code (if any)	Year of offeri	No. of times offered during the same year	Duration of course	Number of students enrolled in the year	Number of Students completing the course in the year
Theory of Pressure Vessel Design	MG-01	2014	1	35 hrs	49	17
Year 2						
Name of the value added courses (with 30 or more contact hours)offered	Course Code (if any)	Year of offering	No. of times offered during the same year	Duration of course	Number of students enrolled in the year	Number of Students completing the course in the year
Essence of Materials Science	MG-02	2015	1	60 hrs	66	22
Year 3						
Name of the value added courses (with 30 or more contact hours)offered	Course Code (if any)	Year of offering	No. of times offered during the same year	Duration of course	Number of students enrolled in the year	Number of Students completing the course in the year
Year 4						
Name of the value added courses (with 30 or more contact hours)offered	Course Code (if any)	Year of offering	No. of times offered during the same year	Duration of course	Number of students enrolled in the year	Number of Students completing the course in the year

13.08.2020

एस. के. सिंह Singh

वैज्ञानिक अधिकारी (एच) एवं वार्डन Scientific Officer (H) and W

मानव संसाधन विकास प्रभाग Human Resource Development D

भाभा परमाणु अनुसंधान केंद्र Bhabha Atomic Research Cen

भारत सरकार Government of India

प्रशिक्षण विद्यालय भवन, अणुशक्तिनगर मुंबई-400 094

Training School Complex, Anushak

Linear Control Systems Theory	EG-13	2017	1	48 hrs	16	6
Natural Circulation Based Passive Safety Systems for	MG-03	2017	1	48 hrs	12	6
Nuclear Fuels and Fuel Cycle	MG-04	2017	1	48 hrs	65	36
Year 5						
Name of the value added courses (with 30 or more contact hours)offered	**Course Code (if any)**	**Year of offering**	**No. of times offered during the same year**	**Duration of course**	**Number of students enrolled in the year**	**Number of Students completing the course in the year**
State - space approach to reactor control	EG-01	2018	1	48 hrs	13	6
Natural Circulation based passive safety system for advanced reactor	M-G03	2018	1	48 hrs	9	5
Advanced computational physics	PY705	2018	1	35 hrs	20	20

Singh 13.08.2020

एस. के. सिंह S. K. Singh
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Training School Complex, Anushaktinagar, Mumbai-400 094

QUEST-Continuing Education Programme of HBNI: **Details** of 12th Set of Courses

HRD Division invites applications from employees of DAE units located in Mumbai/ Navi Mumbai, and from HBNI students for 3 Advanced Courses details of which are given on the next page:

- **Each c**ourse will comprise about 32 lectures of 1.5 hours (1 hour and 30 minutes) duration. There will be 2 lectures per week for each course. The lectures will be held at BARC Training School, Anushaktinagar and as far as possible during nonoffice hours. The exact timetable and schedule of course(s) to be offered will be notified later based on the nomination response received for the same.
- These advanced courses are offered to the DAE employees subject to approval from competent authority (Head of Division or equivalent within BARC & other DAE units in Mumbai/ Navi Mumbai). Students pursuing M.Tech/ M.Sc. (Engg)/ Ph.D. programmes of HBNI may forward the applications through their respective guides.
- A candidate can be enrolled in for up to 2 advanced courses only.
- It is mandatory that the interested employees/ HBNI students enrolled for the Course(s) have a minimum of 80% attendance in the lectures to be eligible to appear in the final written examination. Kindly note that certificates will be issued only to those who appear in the written examination and score an aggregate of 50% or more in home/classroom assignments & written examinations taken together.

Interested eligible employees and HBNI students meeting the specified eligibility criteria, wherever applicable, may forward their applications/ nominations through their Division Head or equivalent competent authority as the case may be, to

Shri S.K. Singh,
HRDD

latest by **20th March, 2019** to ensure programme implementation as envisaged above.

Detailed course content and Application-cum-Nomination Form is available on BTS>HRD>CEP>QUEST

Kindly note that a course will be offered subject to the receipt of a minimum number of applications in the same and decision of the coordinator/ Faculty concerned will be final in this regard.

QUEST- Continuing Education Programme of HBNI

Details of Proposed 12th Set of Courses

S. No.	Course Code	Course Title	Eligibility	Faculty/ Associate faculty

1	**EG-A01**	State-space approach to Reactor Control	Engineering Graduates (Electrical/ Instrumentation/ Electronics/ Computer/ Chemical) having undergone Basic Course in Control Theory at UG Level	**Faculty:** Dr. A.P. Tiwari OS/ Head, HRDD **Associate Faculty**: Dr. S. R. Shimjith RCSDS, RCnD
2	**EG-A12**	Signal Conditioning & Recovery	Engineering graduates (Electrical/Electronics /Chemical/ Instrumentation)	**Faculty:** Dr. S. Mukhopadhyay OS/ Head, SD
3	**MG-03**	Natural Circulation Based Passive Safety Systems for Advanced Reactors	(1)Engineering graduates (Mechanical/ Chemical) **OR** (2) Engg graduates in other disciplines/ Masters in Physics or Chemistry: having good background knowledge of heat transfer and fluid flow	**Faculty:** Dr. P.K. Vijayan, RRF Formerly, Director, RDDG,BARC

1. State-space approach to Reactor Control:

(Course **coordinator:** Dr. A.P. Tiwari, BARC)

Pre-requisites:	**Faculty:**
Control theory fundamentals & state space approach, Engineering Mathematics, Reactor Instrumentation.	Dr. A.P. Tiwari, OS/ Head, HRDD **Associate Faculty**: Dr. S.R. Shimjith, RCSDS, RCnD

Introduction & Preliminary Concepts: Components of a nuclear reactor, Neutron balance, Reactivity Control, Neutron Reaction Cross-sections, Fission rate & power, Prompt and Delayed neutrons, Neutron life time.

Mathematical Modeling of Nuclear Reactors: Neutron diffusion equation, Derivation of Point kinetics model for zero power operation, Linearization & representation into standard state space form, Controllability , Observability and stability properties, Step response of Nonlinear and linearized forms of Point kinetics model, Log rate and Reactor period.

Internal Reactivity Feedback Effects: Moderator, Coolant and Fuel Temperature dependent reactivity feedbacks, void/density dependent reactivity feedbacks, Fission product poisoning, xenon dependent reactivity feedbacks, Modeling of Internal Reactivity Feedback effects, Effect of Internal feedbacks on stability.

Mathematical modeling of Large Reactors: Limitations of point kinetics model, Space-time kinetics modeling principles, derivation of modal and nodal models, linearization and representation into standard form, incorporating internal feedback effects into space-time kinetics model, Controllability, observability and stability properties.

Signals for Reactor Control: Start-up, intermediate and power range instrumentation, Excore signals, Incore signals, Thermal power, Need and schemes for correction of neutronics signals with thermal signals.

Reactor Control Design: Control of total power and power distribution, Significance of feedback of total power, Log rate and linear rate, Design of State feedback control and observer.

Mathematical Modeling of Plant: Modeling of SG/SD level and pressure variations, Turbine and Condenser, Feed Control valves.

Plant Control: Power plant programming - constant Tav program, constant pressure program, Level and pressure control, Bleed condenser pressure and level control, Pressurizer pressure and level control.

2. Signal Conditioning & Recovery:

(Course **coordinator:** Dr. S. Mukhopadhyay, BARC)

Engineering graduates (Electrical/Electronics/ Chemical/ Instrumentation)	**Faculty:** Dr. S. Mukhopadhyay OS/ Head, Seismology Division

Conditioning raw signals from transducers, signal extraction from a common mode reference, Error budget in Signal Conditioning circuits, Recovery of Signal buried in Noise, Phase Lock Loops, Lock-in Amplifiers, Noise Equivalent circuits, Advances in A/D and D/A technology, Sigma-Delta converters, Analysis of quantization errors, Application of decimation and interpolation to A/D and D/A conversion, over-sampling, design of digital anti-aliasing filters, fast algorithms for implementation, Function space, orthogonal basis functions, Limitation of Shanon's theorem, Reconciliation by approximation in shift invariant space, generalized basis functions, analysis and reconstruction with B-spline basis, wavelet basis, bi-orthogonal wavelet (dual) basis, consistent estimate (sampling), Interpolating wavelets, perfect reconstruction with wavelets, over-sampling, multi-scale characterization from extremas in wavelet domain.

3. Natural Circulation Based Passive Safety Systems for Advanced Reactors:

(Course **coordinator:** Dr. P.K. Vijayan, RRF, DAE)

(1) Engineering graduates (Mechanical/ Chemical) **OR** (2) Engg graduates in other disciplines/ Masters in Physics or Chemistry: having good background knowledge of heat transfer and fluid flow	**Faculty**: Dr. P.K. Vijayan, RRF Formerly, Director, RDDG, BARC

Natural circulation systems - brief history, working principle, advantages and challenges, review of applications in nuclear systems and classification of natural circulation systems.

Analysis of natural circulation systems - governing equations for single-phase, two-phase and supercritical closed loop and open loop systems, steady state analysis of

single-phase, two-phase and supercritical systems, generalized flow equation, parametric effects and natural circulation performance of advanced reactor coolants.

Transient analysis of single-phase, two-phase and supercritical systems, numerical models, solution procedure and analysis of various transients and parametric influences.

Introduction to instability, classification of instabilities, static and dynamic stability analysis of single-phase, two-phase and supercritical systems, parametric influences.

Experimental database of simple loop facilities, Designing for Stability in natural circulation BWRs, CHF controlled and stability controlled designs, minimum decay ratio line and operating line concept.

Coupled natural circulation systems, series coupled, parallel coupled and series-parallel coupled systems.

Integral test facilities and scaling philosophy of natural circulation systems, Ishii's scaling philosophy and power-to-volume scaling philosophy.

Introduction to thermo-syphon heat transport devices and their analysis methods.