



DRAVIDIAN UNIVERSITY
Centre for Off-Campus Education & Research
Syllabus for M.Phil/Ph.D Mathematics
Paper II: Broad Field

Unit – I: ALGEBRA

Modules and Vector spaces: Definition and examples, Sub modules and direct sums, R-homomorphisms and quotients modules, completely reducible modules, free modules. *Noetherian and Artinian modules and rings:* $\text{Hom}_R(M_i, \ominus M_i)$ Noetherian and Artinian modules, Wedderburn – Artin theorem, Uniform modules, primary modules, and Noether – Laskar theorem. Standard as in “Basic abstract Algebra “by P.B. bhattacharya, S.K.Jain and S.R.Nagpaul, Chapter 14 (Sections 1 to 5) and chapter 19 (sections 1t to 4)

Unit – II: GRAPH THEORY AND NUMBER THEORY

Graphs in Switching and Coding theory: Contact networks, analysis of contact networks, synthesis of contact networks, sequential switching networks, unit cube and its graph, graphs in coding theory Standard as in “Graph theory with applications to engineering and computer science “by Narasingh Deo, chapter 12 (sections 12.1 to 12.6)

Periodic Arithmetical Functions and Gauss Sums: Functions periodic modulo K, Existence of finite Fourier series for periodic arithmetical functions, Ramanujan’s sum and generalizations, Multiplicative properties of the sums $S_{\kappa}(n)$.

Standard as in “Analytic Number Theory “by Tom Apostol “, chapter 8 (sections 8.1 to 8.4)

Unit – III: FLUID DYNAMICS

Fundamental equations of the flow of viscous compressible fluids: The equations of continuity – equations of motion (Navier Stokes Equations – The energy equation.

Laminar flow of viscous incompressible fluids: Similarity of flows – The Reynolds number – flow between parallel flat plates – Steady flow in pipes – Flow through a pipe – The Hagen – Poiseuille flow – Flow between tow coaxial cylinders – flow between two concentric rotating cylinders.

Standard as in “Foundations of Fluid Mechanics “ by S.W.Yuan, Prentice Hall.
Chapter 5 (Sections 5.1 to 5.3) and Chapter 8 (Sections 8.1 8.3 to 8.5)

Unit – IV: OPERATIONS RESEARCH

Net work scheduling by PERT/CPM

Introduction, Network and Component, Logical Sequencing, Rules of Network Construction, Critical Path Analysis, Probability considerations in PERT, Distinction between PERT AND CPM.

Standard as in” Operations Research “ by Kanti Swaroop, P.K.gupta, Man Mohan, chapter 21 (Sections 21.1 to 21.7)

Unit – V: MATHEMATICAL MODELLING

Models for Blood Flows. Basic concepts about blood, cardiovascular system and Blood flows – Steady Non-Newtonian fluid flows in circular tubes – Newtonian Pulsatile flows in Rigid and Elastic tubes – Blood fow through Artery with Mild stenosis.

Standards as in” Mathematical Models in biology and Medicine” by J.N.Kapur, Affiliated East-West Press Pvt. Ltd., New Delhi (1985), Chapter 11 (Sections 11.2 11.5).

Note: TWO QUESTIONS ARE TO BE SET FROM EACH UNIT.

PAPER – II : Broad Field

Time : 3 Hours

Max Marks: 100

Answer Any Five Questions
All Question Carry Equal Marks

5 x 20 = 100

1.
 - a) Define a sub module. State and Prove the fundamental theorem of R-homomorphism.
 - b) Let M be a finitely generated free module over a commutative ring R. Then show that all bases of M have the same number of elements.
2.
 - a) State and prove the first basis theorem.
 - b) Show that the sum of the nilpotent ideals in a Noetherian ring R is a nilpotent ideal.
3. Explain the problems that arise in the theory of sequential machines.
4.
 - a) Let Z_0, Z_1, \dots, Z_{k-1} be K distinct complex numbers and let W_0, W_1, \dots, W_{k-1} be K complex numbers which need not be distinct. Show that there exist a unique polynomial $p(z)$ of degree $\leq (k-1)$ such that $P(Z_m) = W_m$ for $m=0, 1, 2, \dots, k-1$
 - b) Let $S_k(n) = \sum_{d|(n,k)} f(d)g\left(\frac{n}{d}\right)$ where f and g are multiplicative. Then show that $S_{mk}(ab) = S_m(a)S_k(b)$ where $(a,k) = (b,m) = 1$
5.
 - a) Derive the Navier-Stokes equations of motion for a viscous, incompressible fluid.
 - b) Derive the energy equation.
6.
 - a) Discuss the steady motion of a viscous, incompressible fluid between two horizontal plates.
 - b) Discuss the steady motion of a viscous fluid between two coaxial cylinders.
7. Show that the entropy of the following probability distribution is $2 - \left(\frac{1}{2}\right)^{n-2}$
 Events : $x_1, x_2, \dots, x_i, \dots, x_{n-1}, x_n$
 Probability (P_i) : $1/2, 1/4, \frac{1}{2^2}, \frac{1}{2^{n-1}}, \frac{1}{2^n}$
8. Compare CPM and PERT explaining similarities and differences.
9.
 - a) Discuss the flow of Herschel Bulkley fluid in circular tube.
 - b) Explain Fahraeus-Lindquist effect.
10. Discuss pulsatile flow in elastic tube.