Reg. No. | | | | | | | | |

G. VENKATASWAMY NAIDU COLLEGE (AUTONOMOUS), KOVILPATTI – 628 502.

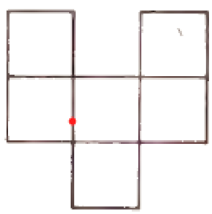
UG DEGREE END SEMESTER EXAMINATIONS - NOVEMBER 2025.
(For those admitted in June 2023 and later)

PROGRAMME AND BRANCH: B.Sc., MATHEMATICS

SEM	CATEGORY	COMPONENT	COURSE CODE	COURSE TITLE
V	PART - III	CORE ELECTIVE-1	U23MA5E1A	COMBINATORIAL MATHEMATICS

Date & Session: 11.11.2025/FN **Time : 3 hours** **Maximum: 75 Marks**

Course Outcome	Bloom's K-level	Q. No.	**SECTION – A (10 X 1 = 10 Marks)** Answer ALL Questions.
CO1	K1	1.	A breakfast cereal competition lists 10 properties of a new make of car and asks the eater to place these properties in order of importance. How many orderings are possible? a) 10 ! b) 8 ! c) 5 ! d) 0 !
CO1	K2	2.	There are 5 seats in a row available, but 12 people to choose from. How many different seatings are possible? a) $\frac{12!}{5!}$ b) $\frac{12!}{7!}$ c) $\frac{5!}{7!}$ d) $\frac{12!}{5!7!}$
CO2	K1	3.	A wholesale company has to supervise sales in 20 towns. Five members of staff are available, and each is to be assigned 4 towns to supervise. In how many ways can the 20 towns be put into 5 groups of 4? a) $\frac{20!}{5!}$ b) $\frac{20!}{4!}$ c) $\frac{20!}{4!5!}$ d) $\frac{20!}{(4!)^5\,5!}$
CO2	K2	4.	If $r < n$, any $r \times n$ Latin rectangle can be extended to an ________________Latin rectangle. a) $(r + 1) \times n$ b) $(r - 1) \times n$ c) $(r \times 1) \times n$ d) $(r \times n)$
CO3	K1	5.	A connected graph with no cycles is called___________. a) complete graph b) bipartite graph c) tree d) digraph
CO3	K2	6.	n-digit integer sequences are to be formed using only the integers 0, 1, 2, 3. For example, 0031 and 3202 are two 4-digit sequences. How many n-digit sequences are there? a) 4^2 b) 4^n c) 4^{2n} d) 4^{n^2}
CO4	K1	7.	$\lvert A \cup B \cup C\rvert =$. a) $\lvert A\rvert + \lvert B\rvert + \lvert C\rvert - \lvert AB\rvert - \lvert AC\rvert - \lvert BC\rvert + \lvert ABC\rvert$ b) $\lvert A\rvert + \lvert B\rvert + \lvert C\rvert - 2\lvert AB\rvert - \lvert AC\rvert - \lvert BC\rvert + \lvert 3ABC\rvert$ c) $\lvert A\rvert + \lvert B\rvert + \lvert C\rvert + \lvert AB\rvert + \lvert AC\rvert + \lvert BC\rvert + \lvert ABC\rvert$ d) $\lvert A\rvert - \lvert B\rvert - \lvert C\rvert - \lvert AB\rvert - \lvert AC\rvert - \lvert BC\rvert + \lvert ABC\rvert$
CO4	K2	8.	From set of size 4 to size 4: How many functions are surjective (onto)? a) 256 b) 150 c) 24 d) 64

CO5	K1	9.	Fisher's inequality uses properties of. a) randomization b) incidence matrix and rank arguments c) F-tests d) Latin squares
CO5	K2	10.	A "uniform" block design means. a) each block has the same number of elements b) each element appears the same number of times c) the design is symmetric d) blocks are pairwise disjoint
Course Outcome	**Bloom's K-level**	**Q. No.**	**SECTION – B (5 X 5 = 25 Marks)** **Answer ALL Questions choosing either (a) or (b)**
CO1	K3	11a.	A sports magazine decides to publish articles on all 22 first division (football) league clubs, one club per week for 22 weeks. In how many ways can this be done if the first article must be about Arsenal? How many if Wolves and Stoke must be featured on consecutive weeks? **(OR)**
CO1	K3	11b.	30 girls, including Miss India, enter a Miss World competition. The first 6 places are announced. (i) How many different announcements are possible? (ii) How many if Miss India is assured of a place in the first six?
CO2	K3	12a.	Write down the 2×2, 3×3 and 4×4 Latin squares. **(OR)**
CO2	K3	12b.	Five jobs are available. For each $i = 1,\ldots,5$, let S_i denote the set of applicants suited for the ith job. $S_1 = \{A, B, C\}, S_2 = \{D, E\}, S_3 = \{D\}, S_4 = \{E\}, S_5 = \{A, E\}$ Can all the jobs be filled?
CO3	K4	13a.	Solve $a_n = 6a_{n-1} - 11a_{n-2} + 6_{n-3}$ if $a_1 = 2, a_2 = 6, a_3 = 20$. **(OR)**
CO3	K4	13b.	There are 4 colours available, discover how many colourings of the k golf balls are possible if there must be an odd number of objects coloured with the first colour?
CO4	K4	14a.	In constructing a 6 x 6 Latin square, the first two rows have been chosen as follows 1 2 3 4 5 6 2 4 1 3 6 5 By Hall's theorem it is definitely possible to find a suitable third row. But how many possibilities are there? **(OR)**
CO4	K4	14b.	Discover the rook polynomial of the board of Figure 
CO5	K5	15a.	Give the opinion about a block design and a suitable example. **(OR)**
CO5	K5	15b.	Justify the following statement that there exists no (12, 8, 3, 2, 1)-configuration.

Course Outcome	Bloom's K-level	Q. No.	**SECTION – C (5 X 8 = 40 Marks)** **Answer ALL Questions choosing either (a) or (b)**
CO1	K3	16a.	Show that $\binom{n}{r} = \binom{n-1}{r-1} + \binom{n-1}{r}$ and also verify $\binom{7}{4} = \binom{6}{3} + \binom{6}{4}$.
			(OR)
CO1	K3	16b.	Show that $(a+b)^n = \sum_{r=0}^{n} \binom{n}{r} a^{n-r} b^r$ and find $(x+y)^7$.
CO2	K4	17a.	If a graph has $2n$ vertices, each of degree $\geq n$, then prove that the graph has a perfect matching.
			(OR)
CO2	K4	17b.	State and Prove the Hall's Marriage Theorem.
CO3	K4	18a.	Prove that a_n formula for number of derangements of n objects using recurrence relation.
			(OR)
CO3	K4	18b.	Solve the equation $x^2 = x + 1$ using Fibonacci sequence.
CO4	K5	19a.	The manager of a firm has 5 employees to be assigned to 5 different jobs. The men are A, B, C, D, E and the jobs are a, b, c, d, e. He considers that A is unsuited for jobs b and c, B unsuited for a and c, C unsuited for b, d and e, D suited for all and F unsuited for d. Evaluate how many ways can he assign the jobs to men suited to them?
			(OR)
CO4	K5	19b.	(i) Measure the rook polynomial for an ordinary 4 x 4 board. (ii) If a chessboard C consists of two non-interfering parts, then prove that the rook polynomial for C is just the product of the rook polynomials for the parts A and B.
CO5	K5	20a.	Prove that a block design each element lies in exactly r blocks, where $r(k-1) = \lambda(v-1)$ and $bk = vr$.
			(OR)
CO5	K5	20b.	State and prove Fisher theorem.