**Paper Title (16 Bold)**

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**ABSTRACT (10 Bold)**

A set *M* of vertices of a connected graph *G* is a monophonic set if every vertex of *G* lies on an *x-*y monophonic path for some elements *x* and *y* in *M.* The minimum cardinality of a monophonic set of *G* is the monophonic number of *G,*and is denoted by *m*(G). A monophonic set of cardinality *m*(G) is called a *m*-set of *G*. Any monophonic set of order *m*(G)is a minimum monophonic set of *G*. An edge monophonic set *M*  in a connected graph *G* is called a minimal edge monophonic set if no proper subset of *M* is a edge monophonic set of *G*. The total edge monophonic set *M* of a graph *G* is a edge monophonic set *M* such that the subgraph induced by *M* has no isolated vertices, and is denoted by *emt(G).* The upper total edge monophonic set of a graph *G* is a minimal total edge monophonic set *M* such that the subgraph induced by *M* has no isolated vertices. The upper total edge monophonic number is the maximum cardinality of a minimal total edge monophonic set of *G,* and is denoted by *e*mt+(*G)*. The upper total edge monophonic number of some connected graphs are realized. It is proved that for any integers, *a, b* and *c* such that *2≤a≤b<c*, there exist a connected graph *G* with *em(G)=a,em*+*(G)=b* and *emt+(G)=c*.

**KEYWORDS:** **(10 Bold)** Monophonic set, monophonic number, edge monophonic set, edge monophonic number, total edge monophonic number, upper total monophonic number, upper total edgemonophonic number.

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1. **INTRODUCTION (10 Bold)**

By a graph *G* = (*V, E*) we mean a simple graph of order at least two. The order and size of *G* are denoted by *p* and *q*, respectively. For basic graph theoretic terminology,we refer to Harary [2]. The neighborhood of a vertex *v* is the set *N*(*v*) consisting of all vertices *u* which are adjacent with *v*. The closed neighborhood of a vertex *v* is the set*N*[*v*] =*N*(*v*) U{*v* }.A vertex *v* is an extreme vertex if the sub graph induced by its neighbors is complete. A vertex *v* is a semi-extreme vertex of *G* if the sub graph induced by its neighbors has a full degree vertex in *N*(*v*). In particular, every extreme vertex is a semi - extreme vertex and a semi - extreme vertex need not be an extreme vertex.

For any two vertices *x* and *y* in a connected graph *G*, the distance *d*(*x, y*) is the length of a shortest *x-y* path in *G*. An *x-y* path of length *d*(*x, y*) is called an *x-y* geodesic.
A vertex *v* is said to lie on an *x-y* geodesic *P* if *v* is a vertex of *P* including the vertices *x* and *y*.The geodetic number of a graph was introduced in [4].The eccentricity *e(v)* of a vertex *v* in *G* is the maximum distance from *v* and *a* vertex of *G*. The minimum eccentricity among the vertices of *G* is the radius, rad (*G*) or *r*(*G*) and the maximum eccentricity is its diameter, diam*G* of *G*.

A chord of a path *u*1, *u*2, …,*u*k in *G* is an edge *uiuj* with *j*≥*i* + 2. An*u-v* path *P* is called a monophonic path if it is a chordless path. A set *M* of vertices is a monophonic set if every vertex of *G* lies on a monophonic path joining some pair of vertices in *M,*and the minimum cardinality of a monophonic set of *G* is the monophonic number of *G,* and is denoted by *m*(G). The monophonic number of a graph *G* was studied in [9]. A monophonic set *M* in a connected graph *G* is called a minimal monophonic set if no proper subset of *M* is a monophonic set of *G.*The upper monophonic number m+(*G*) of *G* is the maximum cardinality of a minimal monophonic set of *G*. The upper monophonic number of a graph *G* was studied in [8]. A set *M* of vertices of a graph *G* is an edge monophonic set if every edge of *G* lies on a*x – y* monophonic path for some elements *x* and *y* in *M*. The minimum cardinality of an edge monophonic set of *G* is the edge monophonic number of *G*, denoted by *em*(*G*). The edge monophonic number of a graph was introduced and studied in [6]. A total edge monophonic set of a graph *G* is a edge monophonic set *M* such that the subgraph induced by *M* has no isolated vertices. The minimum cardinality of a total edge monophonic set of *G* is the total edge monophonic number, denoted by *emt*(*G*). The total edge monophonic number of a graph G was studied in [1]. An edge monophonic set *M* in a connected graph *G* is called a minimal edge monophonic set if no proper subset of *M* is an edge monophonic set of *G*. The upper edge monophonic number *e*m+(*G*) of *G* is the maximum cardinality of a minimal edge monophonic set of *G*. The upper edge monophonic number of a graph *G* was studied in [7]. The upper total edge monophonic set of a graph *G* is a minimal total edge monophonic set *M* such that the subgraph induced by *M* has no isolated vertices. The upper total edge monophonic number is the maximum cardinality of a minimal total edge monophonic set of *G,* and is denoted by *e*mt+(*G)*.

The following Theorems will be used in the sequel.

Theorem 1.1[6 ]: Each simplical vertex of G belongs to every edge monophonic set of G.

Theorem 1.2[7]: No cut vertex of G belongs to any minimal edge monophonic set of G.

Theorem1.3[9]: Each extreme vertex of a connected graph *G* belongs to every monophonic set of *G*.

Theorem 1.4[9] **:** Let *G* be a connected graph with diameter *d*. Then *m*(G) ≤ *p*-*d*+1.

Theorem 1.5[8] :Let *G* be a connected graph with cut vertices and *M* be a minimal monophonic set of *G*. If *v* is a cut vertex of *G*, then every component of *G-v* contains an element of *M.*

Theorem 1.6 [1] : Let *G* be a connected graph with cut vertices and *M* be total edge monophonic set of *G*. If *v* is a cut vertex of *G*, then every component of *G-v* contains an element of *M.*

Throughout this paper *G* denotes a connected graph with atleast two vertices.

**The Upper Total Edge Monophonic Number of a Graph**

**Definition 2.1:**

The total edge monophonic set *M* in a connected graph *G* is called a minimal total edge monophonic set if no proper subset of *M* is a total edge monophonic set of *G*. The upper total edge monophonic number em*t+*(*G*) is the maximum cardinality of a minimal total edge monophonic set of *G*.

**Example 2.2:** For the graph *G* given in figure 2.1, *M1* = {*v*1*,v3*} is the only minimum edge monophonic set of *G*, so that *m(G)* =2. *M2* = {*v1,v3,v4*} is the minimum total edge monophonic set of *G*, so that *emt(G)* = 3. The set *M3* = {*v2,v4,v5*} is the only minimal edge monophonic set of *G*, so that *em+(G)* = 3. *M4* = {*v2,v3,v4,v5*} is the total edge monophonic set of *G*and it is clear that no proper subset of *M*4is an total edge monophonic set of G, and so*M*4is a minimal total edge monophonic set of *G* so that *emt+(G*) ≥4. It is easily verified that no five elements set of *G* is the total edge monophonic set of *G*. Hence it follows that *em*t+(*G*) = 4



**Figure: 2.1**

**Remark 2.3**: Every minimum total edge monophonic set of *G* is a minimal total edge monophonic set of *G* and the converse is not true. For the graph *G* given in Figure 2.1, *M4*= {*v2,v3,v4,v5*} is a minimal total edge monophonic set but not a minimum total edge monophonic set of G.

**Theorem 2.4**: For any connected graph *G*,2≤*emt(G)≤em+t(G*)≤*p*

**Proof :**Any total edge monophonic set needs atleast 2 vertices and so e*m*t(*G*) ≥2. Since every minimal total edge monophonic set is the total edge monophonic set ,e*mt*(*G*) ≤ e*m*t+ (*G*). Also since *V*(*G*) is the total edge monophonic set of *G*, it is clear that e*mt*+ (*G*) ≤ *p.* Thus 2 ≤ e*mt*(*G*) ≤ *em*t+(*G*) ≤ *p*.

**Theorem 2.5**: For any connected graph G, *emt(G) =p* if and only if em+t*(G)* = *p*

**Proof:**If *emt(G*) =*p*, then *M = V(G*) is the unique minimal total edge monophonic set of *G*. Since no proper subset of *M* is the total edge monophonic set, it is clear that *M* is the unique minimal total edge monophonic set of *G* and so *em+t(G)* = *p*. The converse part follows from Theorem 2.4.

**Theorem 2.6 :**For the complete graph *KP*(*p* ≥ 2), e*m*t+(*K*p) = e*m*+(*K*p) = *p*.

**Proof :** Since every vertex of the complete graph *Kp* (*p* ≥ 2) is an extreme vertex, the vertex set of *Kp* is the unique monophonic set and the minimal total edge monophonic set contains all the vertices.Thuse*m*+(*Kp*) = e*m*t+(*Kp*) = *p.*

**Theorem 2.7**: Let *G*be a connected graph of order p with *emt(G*) = *p-*1.Then *emt+(G*)=*p-*1.

Proof: Since *emt(G*) = *p-1*, it follows from Theorem 2.4,*em*t+(*G*) = *p* or *p-1*. If *emt+(G)* =p, then by Theorem 2.5,*emt(G*)= *p*,which is a contradiction. Hence *emt+(G)* = *p-1.*

**Theorem 2.8 :** For a connected graph *G* of order *p*, the following are equivalent:

1. *em*t+(*G*) = *p*
2. *em*(*G*) = *p*
3. *G* = *Kp*

**Proof :**(i)=>(ii). Let *em*+*t*(*G*) = *p*. Then *M = V(G*) is the unique minimal total edge monophonic set of *G*. Since no proper subset of *M* is a edge monophonic set, it is clear that *M* is the unique minimum totaledge monopnic set of *G* and so *em*(*G*) = *p*.

(ii)=>(iii). Let *em*(*G*) = *p*. If *G* ≠ *Kp*, then by theorem 1.2, *m*(*G*) ≤ *p*-1, which is a condradiction. Therfore*G* =*Kp.* (iii) ⇒ (i). Let G = Kp. Then by Theorem 2.5,*emt*+(*G*) =*p.*

**Theorem 2.9 :** Let *G* be a connected graph with cut vertices and *M*  be a minimal monophonic set of *G*. If *v* is a cut vertex of *G*, Then every component of *G*-*v* contains some vertices of *M*.

**Proof**: Since every minimal total edge monophonic set is also a total edge monophonic set, the result follows from Theorem 1.5 and Theorem 1.6.

**Theorem 2.10**: For any connected graph *G*, no cut vertex of *G* belongs to any minimal total edge monophonic set of *G*.

**Proof :** Let *M* be a minimal total edge monophonic set of *G* and *v*∈*M* be any vertex. We claim that *v* is not a cut vertex of *G*. Suppose that *v* is a cut vertex of *G*. Let *G1*,*G2*, ..., *G*r(*r* ≥ 2) be the components of *G*-*v*. By theorem 2.9, each component *Gi*, (1 ≤ *i* ≤ *r*) contains an element of *M*. Let *M1* =*M* - {*v*}. Let *uw* be an edge of *G* which lies on a monophonic path P joining a pair of vertices *u* and *v* of *M*. Assume without loss of generality that *u*∈*G1*. Since *v* is adjacent to atleast one vertex of each *Gi*(1 ≤ *i* ≤ *r)*, assume that *v* is adjacent to *z* in *G*k, *k* ≠ 1. Since *M* is an edge monophonic set*, vz* lies on a monophonic path *Q* joining *v* and a vertex *w* of *M* such that *w* must necessarily belongs to *G*k. Thus *w* ≠ *v*. Now, since *v* is a cut vertex of *G*, *P∪ Q* is a path joining *u* and *w* in *M* and thus the edge*uv* lies on this monophonic path joining two vertices of *M*1. Hence it follows that every edge of *G* lies on a monophonic path joining two vertices of *M1,* which shows that*M1* is a edge monophonic set of *G.*Since *M*1$⊊$*M,* this contradicts the fact that *M* is a minimal total edge monophonic set of *G*. Hence *v*∉*M*,so that no cut vertex of *G* belongs to any minimal total edge monophonic set of *G*.

**Theorem 2.11:** For any Tree *T* with *k* vertices, *em*t+(*T)* = *k*.

**Proof:** By Theorem 1.3, any monophonic set contains all the end vertices of *T*. Hence it follows that, the set of all end vertices of *T* is the unique minimal edge monophonic set of *T,* so that *em+t*(*T*) = *k.*

**Theorem 2.12:** For a cycle *G* = *Cp*(*p*≥4), *m*+*t*(*G*) = 3.

**Proof :** First suppose that *G* = *C*3. It is a complete graph, by Theorem 2.5, we have *em*+*t*(*G*) = 3. For any cycle ,suppose that *em+*t(*G*) > 3, then there exist a minimal total edge monophonic set *M*1 such that | *M1*| ≥3. Now it is clear that edge monophonic set *M*$⊊$*M*1, which is a contradiction to *M*1 is a minimal total edge monophonic set of *G.*Therfore*em+*t(*G*) = 3.

**Theorem 2.13:** For the complete bipartite graph *G* = *Km,n.*

1. *emt*+(*G*) =2 if *m* = *n* = 1
2. *em*+t(*G*) = *n*+1 if *m* = 1, *n* ≥2
3. *emt*+(G) = *max*{*m,n*}+1, if *m,n* ≥2.

**Proof:** (i) and (ii) follows from Theorem 2.10. (iii) Let *m,n* ≥ 2. Assume without loss of generality that *m≤n.* First assume that *m*<*n*. Let *X* = {*x*1, *x2,*…,*xm*} and *Y* = {*y1*, *y2*, ..,*yn*} be a bipartion of *G*. Let *M* = *Y*. We prove that *M* is a minimal total edge monophonic set of *G*. Any edge*y*i*xj*(1≤*i*≤ *n,1≤j≤m*) lies on a monophonic path *yi,,xj,,yk* for *k* ≠ i so that *M* is a edge monophonic set of *G*. Let *M*'⊊*M* **.** Then there exists a vertex *yj*∊*M* such that *yj*∉*M*′.Then the edge*yjxi* (1≤ *j* ≤*m,1≤i≤n*) does not lie on a monophonic path joining a pair of vertices of *M***′.** Thus *M***′** isnot aedgemonophonic set of *G*. This shows that *M* is a minimal edge monophonic set of *G*. Hence *emt+*(*G*) ≥ *n.* Let *M*1 be a minimal edge monophonic set of *G* such that ∣*M1*∣ ≥ *n*+1. Since the vertex *xiyj* (1≤*i* ≤*m* and 1≤ *j* ≤*n*) lies on a monophonic path *xixkyj*for any *k* ≠ *i*, it follows that *X* is an edge monophonic set of *G*. Hence *M*1 cannot contain *X.*Similarly ,since Y is a minimal edge monophonic set of G, M1 cannot contain Y also. Hence *M*1⊊*X'∪Y***′ ,**where*X̍̍̍*⊊*X*  and *Y***′**⊊*Y*. Hence there exist a vertex *xi*∊*X*(1≤ *i*≤ *m*) and a vertex *yj*∊Y (1≤*i≤n*) such that*xiyj*∉*M1*. Hence the edge *xiyj*does not lie on a monophonic path joining a pair of vertices of *M*1. It follows that *M*1 is not aedge monophonic set of *G*, which is a contradiction. Thus *M i*s a minimal total edgemonophonic set of *G*. Hence *emt*+(*G*) = max{*m, n*}+1.

**Realization Results**:

**Theorem 3.1:**

 For every positive integers *a*,*b* and *c* where 2 ≤ *a*≤ *b*<*c*, there exists a connected graph *G* with *em*(*G*) = *a*, *em*(*G*) = *b* and *em*+*t*(*G*) = *c*.

**Proof:**

 Let *V*(*K*2) = {*u,x*} and *V*[*Kb-a+*1] = {*v1,v2,. . .,vb-a+*1}. Let *H* =*Kb-a+*1+*K*2. Let *G* be the graph in figure 3.1 obtained from *H* by adding *a-1* new vertices *x1,x2, . . . ,xa-1* and joining each vertex *xi*(1 ≤*i*≤ *a-1*) with *x*. Subdivide the edge *xxi*, where 1 ≤*i*≤ *c-b-1*, calling the new vertices *y1,y2, . . . ,yc-b-1* , where *xi*is adjacent to *yi*and *y*i is adjacent to *x* for all *i*∊{*1,2, . . .,c-b-*1}. The graph *G* is shown in figure 3.1.

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**Figure 3.1**

Let *M* = {*x1,x2, . . . xa-1*} be the set of all end vertices of *G.* Clearly *M* is a subset of every edge monophonic set of *G*. Let *M*1 = *M*ᴜ {*u*}. Then *M*1 is an edge monophonic set of *G*, so that *em*(G) = *a.* Now *T* =*M* ᴜ {*v*1,*v*2, . . . ,*vb-a*+1} is an edge monophonic set of *G*. We show that *T* is a minimal edge monophonic set of *G*. Clearly, no proper subset of *T* is an edge monophonic set of *G*. Hence *T* is a minimal edge monophonic set of *G*,so that *em*+(*G*) = *a-1+b-a+1* = *b*. Also *M*2 =*T*ᴜ{*y1,y2*, . . . ,*yc-b-1* , *x*} is a minimal total edge monophonic set of G,*emt+*(*G*) = *c.*

**Theorem 3.2:** For positive integers *rm,dm* and *l*≥ 5 with *rm*<*dm*≤ 2*rm*, there exists a connected graph *G* with radm(*G*) = *rm*, diam*m*(*G*) = *dm* and *emt+*(*G*) = *l.*

 Let *rm = 1.* Let*rm*≥ 2. Let $C\_{r\_{m+2}}:$*v1,v2, . . . ,*$v\_{r\_{m+2}}$ be a cycle of length$r\_{m+2}$andlet$P\_{d\_{m}-r\_{m}}: $*u0,u1,u2,* . . . ,$u\_{d\_{m} -}r\_{m}$ be a path of length *dm-rm+1*. Let *H* be a graph obtained from$C\_{r\_{m}+2}$andby identifying*v*1 in $C\_{r\_{m}+2}$and *u0*in$P\_{d\_{m}-r\_{m}+1}$. Now add *l-5* new vertices*w1,w2, . . . ,wl-*5 to *H* and join each *wi*(1≤*i*≤*l-5*) to the vertex $u\_{d\_{m}-r\_{m}-1}$and obtain the graph *G* of Figure 3.2.



1. **Figure 3.2 (10 Bold)**

Then rad*m*(*G*) = *rm*, diam*m*(*G*) = *d. Let M ={w1,w2, . . . ,wl-5*,$u\_{d\_{m}-r\_{m}}$} be the set of all end vertices of *G* . It is clear that *M* is not an edge monophonic set of *G* and so *em*(*G*) ≥ *l*. The set *M* ᴜ {*x*}, where *x*∊ {*v3,v4, . . . ,*$v\_{r\_{m}+1}$} is an edge monophonic set of *G* . We show that *em+t*(*G*) = *l*. Now *M1* = *M* ᴜ {*v2,*$v\_{r\_{m}+2}$} is a minimal edge monophonic set of G and so *em*+(*G*) ≥ *l*. Suppose that *em*+(*G*) ≥ *l+*1 . Then there exists a minimal edge monophonic set *T* such that ǀ*T*ǀ ≥ *l+2*. Hence there exists *y*∊*T* such that *y*∉*M1*. By Theorem 1.1, *M*⊂*T.*If *y*∊ {*v3,v4, . . . ,*$v\_{r\_{m}+1}$}, then *M* ᴜ {*y*} is an edge monophonic set of *G*, which is a contradiction to *T* is a minimal edge monophonic set of *G*. If *y*∉ {*v3,v4, . . . ,*$v\_{r\_{m}+1}$},then by corollary 1.1, *y*∉*M*. Therfore*y* = *ui*(0 ≤ *i* ≤ *dm-rm-*1). By Theorem 1.2,*y*∉*T*, which is a contradiction . Thus *M1* is a minimal edge monophonic set of *G* . Now*M2= M1*ᴜ{$u\_{d\_{m}-r\_{m}-1 }$,*v1*} is a minimal total edge monophonic set of *G*. It is clear that no proper subset of *M2* is a total edgemonophonic set of G, so that *emt+(G*) = *l.*

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Let *rm* ≥ 2. Let *Crm+*2: *v1,v2, . . . ,vrm+*2 be a cycle of length *rm+2* and let *Pdm-rm+1*: *u0,u1,u2,* . . . ,*udm-rm* be a path of length *dm-rm+1*. Let *H* be a graph obtained from *Crm*+2  and*Pdm-rm*+1 by *v*1 in *Crm*+2 and *u0* in *Pdm-rm*+1. Now add *l-5* new vertices *w1,w2, . . . ,wl-*5 to *H* and join each *wi*(1≤ *i*≤ *l-5*) to the vertex *udm-rm-*1 and obtain the grThenrad*m*(*G*) = *rm*, diam*m*(*G*) = *dw1,w2, . . . ,wl-5*,*udm-rm*} be the set of all end vertices of *G* .It is clear that *M* is not an edge monophonic set of *G* and so *em*(*G*) ≥ *l*. The set *M* ᴜ {*x*}, where *x*∊ {*v3,v4, . . . ,vrm+*1} is an edge monophonic set of *G* . We show that *em+t*(*G*) = *l*. Now *M1* = *M* ᴜ {*v2,vrm+*2 } is a minimal edge monophonic set of G and so *em*+(*G*) ≥ *l*. Suppose that *em*+(*G*) ≥ *l+*1 . Then there exists a minimal edge monophonic set *T* such that ǀ*T*ǀ ≥ *l+2*. Hence there exists *y*∊*T* such that *y*∉*M1*. By Theorem 1.1, *M*⊂*T.*If *y*∊ {*v3,v4, . . . ,vrm+*1}, then *M* ᴜ {*y*} is an edge monophonic set of *G*, which is a contradiction to *T* is a minimal edge monophonic set of *G*. If *y*∉ {*v3,v4, . . . ,vrm+1*},then by corollary 1.1, *y*∉*M*. Therfore*y* = *ui*(0 ≤ *i* ≤ *dm-rm-*1). By Theorem 1.2, *y*∉*T* ,which is a contradiction . Thus *M1* is a minimal edge monophonic set of *G* . Now *M2= M1*ᴜ{*udm*-rm-1,*v1*} is a minimal total edge monophonic set of *G*. It ``````` of *M2* is a total edge monophonresult follows from Theorem 2.9. Let

Then rad*m*(*G*) = *rm*, diam*m*(*G*) = *dw1,w2, . . . ,wl-5*,*udm-rm*} be the set of allis clear that *M* is not an edge monophonic set of *G* and so *em*(*G*) ≥ *l*. The set *M* ᴜ {*x*}, where *x*∊ {*v3,v4, . . . ,vrm+*1} is an edge monophonic set of *G* . We show that *em+t*(*G*) = *l*. Now *M1* = *M*ᴜ {*v2,vrm+*2 } is a minimal edge monophonic set of G and so *em*+(*G*) ≥*l*. Suppose that *em*+(*G*) ≥ *l+*1 . Then there exists a minimal edge monophonic set *T* such that ǀ*T*ǀ≥*l+2*. Hence there exists *y*∊*T* such that *y*∉ *M1*. By Theorem 1.1, *M*⊂ *T.*If *y*∊ {*v3,v4, . . . ,vrm+*1}, then *M*ᴜ {*y*} is an edge monophonic set of *G*, which is a contradiction to *T* is a minimal edge monophonic set of *G*. If *y*∉ {*v3,v4, . . . ,vrm+1*},then by corollary 1.1, *y*∉*M*. Therfore*y* = *ui*(0 ≤ *i*≤ *dm-rm-*1). By Theorem 1.2, *y*∉*T* ,which is a contradiction . Thus *M1* is a minimal edge monophonic set of *G* . Now *M2= M1*ᴜ{*udm*-rm-1,*v1*} is a minimal total edge monophonic set of *G*. It ``````` of *M2* is a total edge monophonic set of G, so **References**

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Let *rm*≥ 2. Let *Crm+*2: *v1,v2, . . . ,vrm+*2 be a cycle of length *rm+2* and let *Pdm-rm+1*: *u0,u1,u2,* . . . ,*udm-rm* be a path of length *dm-rm+1*. Let *H* be a graph obtained from *Crm*+2  and*Pdm-rm*+1 by *v*1 in *Crm*+2 and *u0* in *Pdm-rm*+1. Now add *l-5* new vertices *w1,w2, . . . ,wl-*5 to *H* and join each *wi*(1≤*i*≤*l-5*) to the vertex *udm-rm-*1 and obtain the graph *G* of Figure 3.2.

Then rad*m*(*G*) = *rm*, diam*m*(*G*) = *dw1,w2, . . . ,wl-5*,*udm-rm*} be the set of all end vertices of *G* . It is clear that *M* is not an edge monophonic set of *G* and so *em*(*G*) ≥ *l*. The set *M* ᴜ {*x*}, where *x*∊ {*v3,v4, . . . ,vrm+*1} is an edge monophonic set of *G* . We show that *em+t*(*G*) = *l*. Now *M1* = *M*ᴜ {*v2,vrm+*2 } is a minimal edge monophonic set of G and so *em*+(*G*) ≥*l*. Suppose that *em*+(*G*) ≥ *l+*1 . Then there exists a minimal edge monophonic set *T* such that ǀ*T*ǀ≥*l+2*. Hence there exists *y*∊*T* such that *y*∉ *M1*. By Theorem 1.1, *M*⊂ *T.*If *y*∊ {*v3,v4, . . . ,vrm+*1}, then *M*ᴜ {*y*} is an edge monophonic set of *G*, which is a contradiction to *T* is a minimal edge monophonic set of *G*. If *y*∉ {*v3,v4, . . . ,vrm+1*},then by corollary 1.1, *y*∉*M*. Therfore*y* = *ui*(0 ≤ *i*≤ *dm-rm-*1). By Theorem1.2, *y*∉*T* ,which is a contradiction . Thus *M1* is a minimal edge monophonic set of *G* .Now *M2= M1*ᴜ{*udm*-rm-1,*v1*} is a minimal total edge monophonic set of *G*. It ``````` of *M2* is a total edge monophonic set of G, so

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