iJRASET
International Journal For Research in Applied Science and Engineering Technology

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY

Volume: 5 **Issue:** VIII **Month of publication:** August 2017

DOI: http://doi.org/10.22214/ijraset.2017.8289

www.ijraset.com

Call: 08813907089 | E-mail ID: ijraset@gmail.com

International Journal for Research in Applied Science & Engineering Technology (IJRASET)
ISSN: 2321-9653; IC Value: 45.98; SJ Impact Factor:6.887
Volume 5 Issue VIII, August 2017- Available at www.ijraset.com

Water Quality Index near Port Area in Visakhapatnam City

M. Santipriya[1], M. Krishna Prasad[2], S. N. Dash[3]
[1]*Environmental engineering, GMR institute of Technology, Rajam-532127*
[2, 3]*Department of chemical engineering, GMR institute of Technology, Rajam-532127*

Abstract*: The present study area is intended to calculate water Quality Index (WQI) near port area in Visakhapatnam city in order to ascertain the quality of water for public utilisation and other purposes. The paper deals with the study on the influence of environmental parameters on the water quality of water body. There are several ways to access the water quality fit for the domestic drinking and other purposes. Water quality index, indicating the water quality in terms of index number. In this study Water Quality Index was determined on the basis of various physic- chemical parameters like pH, electrical conductivity, TDS, Alkalinity total hardness, chloride, nitrate, sulphate.

Keywords: ***water quality index, environmental parameters, physic-chemical parameters, Visakhapatnam city, quality of water***

I. INTRODUCTION

The quality of any body of surface or ground water is a function of either both natural influences and human influences. Without human influences water quality would be determined by the weathering of bedrock minerals, by the atmospheric processes of evapotranspiration and the deposition of dust and salt by wind, by the natural leaching of organic matter and nutrients from soil, by hydrological factors that lead to runoff, and by biological processes within the aquatic environment that can alter the physical and chemical composition of water.

Typically, water quality is determined by comparing the physical and chemical characteristics of a water sample with water quality guidelines or standards. Drinking water quality guidelines and standards are designed to enable the provision of clean and safe water for human consumption, thereby protecting human health. These are usually based on scientifically assessed acceptable levels of toxicity to either humans or aquatic organisms.

Declining water quality has become a global issue of concern as human populations grow, industrial and agricultural activities expand, and climate change threatens to cause major alterations to the hydrological cycle.

Globally, the most prevalent water quality problem is eutrophication, a result of high-nutrient loads (mainly phosphorus and nitrogen), which substantially impairs beneficial uses of water. Major nutrient sources include agricultural runoff, domestic sewage (also a source of microbial pollution), industrial effluents and atmospheric inputs from fossil fuel burning and bush fires. Lakes and reservoirs are particularly susceptible to the negative impacts of eutrophication because of their complex dynamics, relatively longer water residence times and their role as an integrating sink for pollutants from their drainage basins. Nitrogen concentrations exceeding 5 milligrams per litre of water often indicate pollution from human and animal waste or fertilizer runoff from agricultural areas.

An emerging water quality concern is the impact of personal care products and pharmaceuticals, such as birth control pills, painkillers and antibiotics, on aquatic ecosystems. Little is known about their long-term human or ecosystem impacts, although some are believed to mimic natural hormones in humans and other species.

A. Study Area

Visakhapatnam is a coastal, port city, often called "The Jewel of the East Coast", situated in the of Andhra Pradesh, located on the eastern shore of India, nestled among the hills of the Eastern Ghats and facing the Bay of Bengal to the east. It is the administrative headquarters of Visakhapatnam District and is also home of the Eastern Naval Command of the Indian Navy. It is the largest city in Andhra pradesh with an area of 550 Km^2, it is primarily an Industrial city, apart from being a port city. It is also home to the Eastern Naval Command.

For present Study 5 locations in the city were selected i.e., Kakani Nagar, Sheela Nagar, Sri nagar, Auto nagar, Gopala patnam. These areas are around 10 kms radius from the port area

II. METHODS AND MATERIALS

Water samples were collected at total 5 locations, for physico-chemical studies. All the samples were analyzed for parameters such as hardness, alkalinity, salts, conductivity, inorganic substance, heavy metals, coliforms etc. Parameters like pH, conductivity, were analyzed at the time of collection in the field. These parameters were analyzed as per the procedures specified in 'Standard Methods for Examination of Water and Wastewater' published by American Public Health Association (APHA). Ground water samples results were compared with IS: 10500 specification and surface water samples results were compared with CPCB Water Quality Criteria. The weighted arithmetic index method has been used for the calculation of WQI of the water body. Further, quality rating or sub index (q_n) was calculated using the following expression.

$q_n = 100(V_n-V_{io})/(S_n-V_{io})$

(let there be n water quality parameter and quality rating or sub index (qn), corresponding to nth parameter is a number reflecting the relative value of this parameter in the polluted water with respect to its standards permissible value.)

q_n = quality rating for the n^{th} water quality parameter

V_n = estimated value of the n^{th} parameter at a given sampling station.

Sn = standard permissible value of the n^{th} parameter.

V_{io} = ideal value of n^{th} parameter in pure water. (i.e., 0 for all other parameters except the parameter pH and dissolved oxygen (7.0 and 4.6 mg/l@)

Unit weight was calculated by a value inversely proportional to the recommended standard value Sn of the corresponding parameter.

$W_n = K/Sn$

W_n = Unit weightfor the n^{th} parameters.

Sn = Standard value for n^{th} parameters

K = Constant for proportionality.

The overall water quality index was calculated by aggregating the quality rating with the unit weight linearly.

$WQI = \Sigma q_n W_n / \Sigma W_n$

Subsurface samples collected monthly once during total 3 months of study period. All the locations of water monitoring are shown in below Table .1

Table .1: Water Sampling Locations in study area

Code	Name of the location
GW1	Kakani Nagar
GW2	Sheela Nagar
GW3	Sri Nagar
GW4	Auto nagar
GW5	Gopala Patnam

In this study, for the calculation of water quality index, sixteen important parameters were chosen. The WQI was calculated by using the standards recommended by the World Health Organisation (WHO)

Table .2: Water quality Index and status of water quality

Water quality Index Level	Water quality status
0-25	Excellent water quality
26-50	Good water quality
51-75	Poor water quality
76-100	Very poor water quality
< 100	Unsuitable for drinking

Table .3 Drinking water quality standards

S.No	Parameter	Standards	Unit Weight (W_n)
1.	pH	6.5-8.5	0.11764
2.	Electrical Conductivity	0	0
3.	Total dissolved solids	500	0.02
4.	Chlorides	250	0.004
5.	Alkalinity	200	0.005
6.	Total Hardness	300	0.0033
7.	Ca Hardness	75	0.013
8.	Mg Hardness	30	0.033
9.	Phosphates	5	0.2
10	Sulphates	200	0.005
11	Nitrates	45	0.022
12	Iron	0	0
13	Sodium	100	0.01
14	Potassium	10	0.1

III. RESULTS

Table 4: Physicochemical parameters of 5 water sampling locations

S.No	Parameters	units	GW1	GW2	GW3	GW4	GW5
1	pH	--	7.83	8.04	7.3	6.89	7.8
2	Electrical Conductivity	--	320	324	315	290	301
3	Total dissolved solids	mg/l	1189	1397	1118	304	875
4	Chlorides	mg/l	60	314	195	44.5	425
5	Alkalinity	mg/l	580	540	340	186	129
6	Total Hardness	mg/l	512	180	544	189	440
7	Ca Hardness	mg/l	168	68	288	104	328
8	Mg Hardness	mg/l	344	112	256	85	112
9	Phosphates	mg/l	0.14	0.26	0.1	0.34	0.51
10	Sulphates	mg/l	192	90	218	41.1	37.6
11	Nitrates	mg/l	0.9	0.6	1.1	2.2	2.86
12	Iron	mg/l	1.95	1.78	1.84	0.81	0.14
13	Sodium	mg/l	156	408	132	22.2	210
14	Potassium	mg/l	8	4	10	6	15

Table .5: Calculation of Water Quality Index of GW1

S.No	Parameter	Observed Values	Standards	Unit Weight (W_n)	Quality Rating (q_n)	W_nq_n
1.	pH	7.83	6.5-8.5	0.11764	92.118	10.83
2.	Electrical Conductivity	320	0	0	0	0
3.	Total dissolved solids	1189	500	0.02	237.8	0.4756
4.	Chlorides	60	250	0.004	24	0.096
5.	Alkalinity	580	200	0.005	290	1.45
6.	Total Hardness	512	300	0.0033	170.	0.56
7.	Ca Hardness	168	75	0.013	224	2.98
8.	Mg Hardness	344	30	0.033	1146.7	38.22
9.	Phosphates	0.14	5	0.2	2.8	0.56
10	Sulphates	192	200	0.005	96	0.48
11	Nitrates	0.9	45	0.022	2	0.04
12	Iron	1.95	0	0	0	0
13	Sodium	156	100	0.01	156	1.56
14	Potassium	8	10	0.1	80	8
				$\Sigma W_n = 0.515$	$\Sigma q_n = 2521.41$	$\Sigma W_nq_n = 65.28$
Water quality index = $\Sigma W_nq_n / \Sigma W_n = 126.5$						

Table .6: Calculation of Water Quality Index of GW2

S.No	Parameter	Observed Values	Standards	Unit Weight (W_n)	Quality Rating (q_n)	W_nq_n
1.	pH	8.04	6.5-8.5	0.11764	94.58	11.12
2.	Electrical Conductivity	324	0	0	0	0
3.	Total dissolved solids	1397	500	0.02	279.4	0.55
4.	Chlorides	314	250	0.004	125.6	0.502
5.	Alkalinity	540	200	0.005	270	1.35
6.	Total Hardness	180	300	0.0033	60	0.2
7.	Ca Hardness	68	75	0.013	90.667	1.2
8.	Mg Hardness	112	30	0.033	373.3	12.4
9.	Phosphates	0.26	5	0.2	5.2	1.04
10	Sulphates	90	200	0.005	45	0.225
11	Nitrates	0.6	45	0.022	1.33	0.0296
12	Iron	1.78	0	0	0	0
13	Sodium	408	100	0.01	408	4.08
14	Potassium	4	10	0.1	40	4
				ΣW_n = 0.515	Σq_n = 11156.4	ΣW_nq_n = 36.77
Water quality index = $\Sigma W_nq_n/ \Sigma W_n$ = 71.27						

Table .7: Calculation of Water Quality Index of GW3

S.No	Parameter	Observed Values	Standards	Unit Weight(Wn)	Quality Rating (qn)	Wnqn
1.	pH	7.3	6.5-8.5	0.11764	85.882	10.1
2.	Electrical Conductivity	315	0	0	0	0
3.	Total dissolved solids	1118	500	0.02	223.6	0.44
4.	Chlorides	195	250	0.004	78	0.312
5.	Alkalinity	340	200	0.005	170	0.85
6.	Total Hardness	544	300	0.0033	181.33	0.604
7.	Ca Hardness	288	75	0.013	384	5.12
8.	Mg Hardness	256	30	0.033	853.33	28.44
9.	Phosphates	0.1	5	0.2	2	0.4
10	Sulphates	218	200	0.005	109	0.545
11	Nitrates	1.1	45	0.022	2.44	0.054
12	Iron	1.84	0	0	0	0
13	Sodium	132	100	0.01	132	1.32
14	Potassium	10	10	0.1	100	10
				ΣW_n = 0.515	Σq_n = 2321.5	ΣW_nq_n = 58.20
Water quality index = $\Sigma W_nq_n/ \Sigma W_n$ = 112.8						

Table .8: Calculation of Water Quality Index of GW4

S.No	Parameter	Observed Values	Standards	Unit Weight(Wn)	Quality Rating(qn)	Wnqn
1.	pH	6.89	6.5-8.5	0.11764	81.059	9.5
2.	Electrical Conductivity	290	0	0	0	0
3.	Total dissolved solids	304	500	0.02	60.8	0.12
4.	Chlorides	44.5	250	0.004	17.8	0.07
5.	Alkalinity	186	200	0.005	93	0.46
6.	Total Hardness	189	300	0.0033	63	0.21
7.	Ca Hardness	104	75	0.013	138.67	1.84
8.	Mg Hardness	85	30	0.033	283.33	9.44
9.	Phosphates	0.34	5	0.2	6.8	1.36
10	Sulphates	41.1	200	0.005	20.55	0.102
11	Nitrates	2.2	45	0.022	4.88	0.108
12	Iron	0.81	0	0	0	0
13	Sodium	22.2	100	0.01	22.2	0.22
14	Potassium	6	10	0.1	60	6
				$\Sigma W_n = 0.515$	$\Sigma q_n = 852.3$	$\Sigma W_n q_n = 29.49$
Water quality index = $\Sigma W_n q_n / \Sigma W_n = 57.167$						

Table .9: Calculation of Water Quality Index of GW5

S.No	Parameter	Observed Values	Standards	Unit Weight(Wn)	Quality Rating(qn)	Wnqn
1.	pH	7.8	6.5-8.5	0.11764	91.765	10.79
2.	Electrical Conductivity	301	0	0	0	0
3.	Total dissolved solids	875	500	0.02	175	0.35
4.	Chlorides	425	250	0.004	170	0.68
5.	Alkalinity	129	200	0.005	64.5	0.322
6.	Total Hardness	440	300	0.0033	146.67	0.48
7.	Ca Hardness	328	75	0.013	437.3	5.83
8.	Mg Hardness	112	30	0.033	373.3	12.4
9.	Phosphates	0.51	5	0.2	10.2	2.04
10	Sulphates	37.6	200	0.005	18.8	0.094
11	Nitrates	2.86	45	0.022	6.35	0.14
12	Iron	0.14	0	0	0	0
13	Sodium	210	100	0.01	210	2.1
14	Potassium	15	10	0.1	150	15
				$\Sigma W_n = 0.515$	$\Sigma q_n =$ 1853.88	$\Sigma W_n q_n = 50.29$
Water quality index = $\Sigma W_n q_n / \Sigma W_n = 97.48$						

IV. DISCUSSION

Water quality Index of the present study areas s calculated from various important physicochemical parameters. The various physic chemical parameters for the study area is analysed and mentioned in the Table 4. Area wise water quality Index was calculated and mentioned in the Table No. 5,6,7,8 and 9.

The water quality rating study clearly shows that, the status of the water body is eutrophic and it is unsuitable for human uses. It is also observed that the pollution load is relatively high in the GW1 when compared with the remaining ground water samples. The above water quality is also supported by the following physicochemical parameters variations observed during the different seasons of the study. Among all the physicochemical parameters selected for the water quality index calculations, pH is an important parameter which determines the suitability of water for various purposes. In present study pH ranged between 6.5 to 8.5. in many of the collections the ph remained exactly neutral.

Electrical conductivity is also found very high. It is found to be high in the Ground water sample 2.

Chloride is one of the most important parameter in assessing the water quality. In present study the concentration of the chloride fluctuated between 314 mg/l, 425 mg/l, 195 mg/l. Chloride was found to be high in the ground water sample 5 and 2 & low in ground water sample 4.

A relatively higher concentration of chlorides and sulphates also indicated the unsuitability of water for domestic use. Hence, application of water quality index technique for the overall assessment of the water quality of a water body is a useful tool.

REFERENCES

[1] Kannan N., Sabu J.: Quality of groundwater in the shallow aquifers of a paddy dominated agricultural river basin, Kerala, India. World Acad. Sci. Eng. Technol. 52, 475–493 (2009)Google Scholar Todd D.K.: Groundwater Hydrology. USA, New York (2001)Google Scholar.

[2] Aydi W., Saidi S., Chalbaoui M., Chaibi S., Ben Dhia H.: Evaluation of the groundwater vulnerability to pollution using an intrinsic and a specific method in a GIS environment: application to the Plain of Sidi Bouzid (Central Tunisia). Arab. J. Sci. Eng. 38, 1815–1831 (2013)CrossRefGoogle Scholar

[3] Sargaonkar A., Deshpande V.: Development of an overall index of pollution for surface water based on a general classification scheme in Indian context. Environ. Monit. Assess. 89, 43–67 (2003)CrossRefGoogle Scholar

[4] Melloul A., Collin M.: Water quality factor identification by the principal components statistical method. Water Sci. Technol. 34, 41–50 (1994)Google Scholar

[5] Vrba, J.; Zoporozec, A.: Guidebook on mapping groundwater vulnerability. In: IAH International Contribution for Hydrogeology, vol. 16. Heise, Hannover (1994)Google Scholar

[6] Robins N.S.: Groundwater quality in Scotland: major ion chemistry of the key groundwater bodies. Sci. Total Environ. 294(1-3), 41–56 (2002)CrossRefGoogle Scholar

[7] Barber C., Bates L.E., Barron R., Allison H.: Assessment of the relative vulnerability of groundwater to pollution: a review and background paper for the conference workshop on vulnerability assessment. J. Aust. Geol. Geophys. 14(2/3), 1147–1154 (1993)Google Scholar

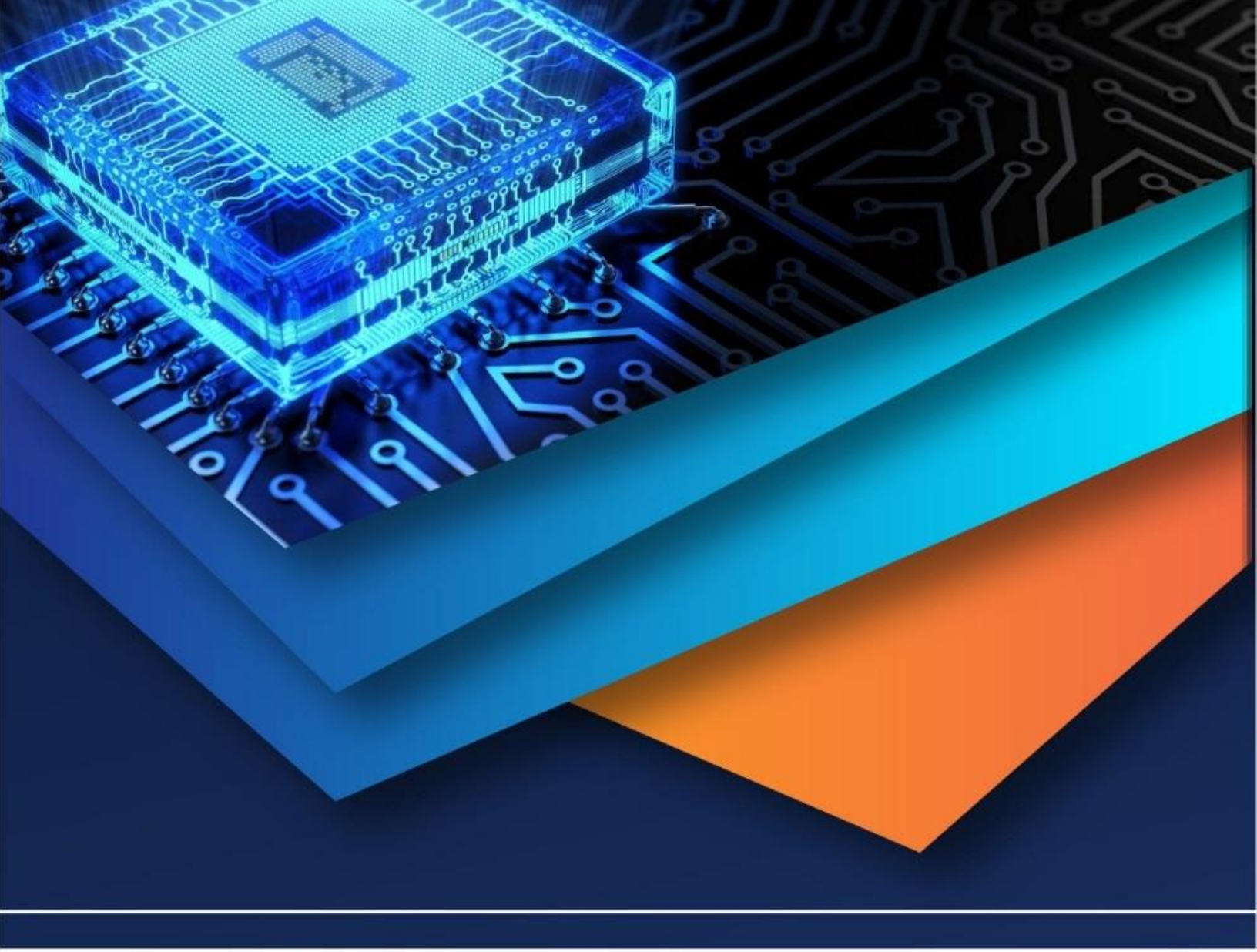
[8] Challerjee R., Tarafder G., Paul S.: Groundwater quality assessment of Dhanbad district, Jharkhand, India. Bull. Eng. Geol. Environ. 69(1), 137–141 (2009)Google Scholar

[9] Swarna Latha P., Nageswara Rao K.: Assessment and spatial distribution of quality of groundwater in zone II and III, Greater Visakhapatnam, India using water quality index (WQI) and GIS. Int. J. Environ. Sci. 1(2), 198–212 (2010)Google Scholar

[10] Swarna Latha P., Nageswara Rao K., Ramesh Kumar P.V., Hari Krishna M.: Water quality assessment at village level a case study. Indian J. Environ. Prot. 27(11), 996–1000 (2007)Google Scholar

[11] Nag S.K., Saha S.: Integration of GIS and remote sensing in groundwater investigations: a case study in Gangajalghati Block, Bankura District, West Bengal, India. Arab. J. Sci. Eng. 39(7), 5543–5553 (2014)CrossRefGoogle Scholar

[12] Yogendra, K.; Puttaiah, E.T.: Determination of water quality index and suitability of urban water body in Shimoga Town, Karnataka. In: Conference Proceedings of the 12th World Lake Conference, Taal (2008)



10.22214/IJRASET

45.98

IMPACT FACTOR: 7.129

IMPACT FACTOR: 7.429

INTERNATIONAL JOURNAL FOR RESEARCH

IN APPLIED SCIENCE & ENGINEERING TECHNOLOGY