

LIST OF FIGURES

Figure No.	Particulars	Page No
2.1	Specifics of India's energy usage, (a) estimated potential of renewable energy as of march 31, 2020, (b) production of petroleum products by type of product (c) yearly wholesale price indices of selected energy commodities, and (d) yearly and state-wide installed capacity of generation of electricity in MW	09
2.2	Schematic diagram of the solar furnace and coordinate systems	13
2.3	(a) Radiation homogenisers with 8 sides, seen from top and (b) Energy flux received at base while using homogeniser is used	14
2.4	Schematic representation of concentrating type collector with CTR	17
2.5	Schematic representation of flat plate type collector with FPTR	17
2.6	Effect of actual reflection on solar photovoltaic with different elevation angles	21
2.7	Experimental results of solar photovoltaic augmented with different types of reflectors	21
2.8	Optimum angle of reflector and receiver to the horizontal plate for a year	24
2.9	Total solar radiation received at the receiver plate throughout the year	24
2.10	Schematic representation of utilisation of FPTR in solar flat plate collector	24
2.11	Mathematical modelling of FPTR with flat plate collector with use of SLR method	25
2.12	Schematic representation of compound parabolic collector with laser light testing method	26
2.13	Actual model of compound parabolic collector with CTR	26
2.14	Circular particle travelled in (a) space and (b) space plus time	28
2.15	Schematic representation of the flowing fluid in to the specific cylindrical domain	29
2.16	Plots of global solar irradiance (I_n), ambient (T_a) and glycerine temperature (T_f) measured for the experiment conducted on 29 th June 2021	34
3.1	Angle made by the solar beam ray to the (a) inclined plane and (b)zenith angle	39
3.2	Schematic representation of solar beam ray reflection and the path follow	41

	inside the FPSRS.	
3.3	Mathematical model of FPSRS.	42
4.1	Schematic of experimental set up with FPSRS and laser light in position.	48
4.2	Test setup and making of FPSRS; (a) reflectors, (b) setup with laser light (inset), (c) assembled FPSRS with TIS and BRS, (d) coordinate system at TIS, (e) coordinate system at BRS, and (f) final setup for experiment.	50
4.3	Schematic explaining rays classification as stated in Table 4.2.	52
4.4	Case wise representation of incident light beam ray's reflection	53
4.5	RDP for different cases (A-F) with change in the value of θ from 20° to 90°	54
4.6	CAD Model of FPSRS with STC, (a) isometric view with hidden supporting plane, (b) isometric view showing supporting and other planes and (c) top view with similar planes	55
4.7	Instances of occurrences of rays from A to D on the FPSRS for different solar incident angle.	57
4.8	Comparative study of the optical performance of present study and the experimental work	58
4.9	Scheme of the rays considered under CAD Model for the cases from (A to F) by considering best suitable sample rays (N= 4).	59
4.10	Optical performance and δ_{\max} for the cases from A to D of FPSRS	61
4.11	Two hypothetical reflectors pyramid angle; (a) reduced by (-1) and (b) increased by (+1)	63
4.12	Distribution of ray and corresponding value of χ for 58° (left) and 62° (right) geometry.	63
4.13	Overall thermal performance of FPSRS	65
5.1	Numerical modelling of the FPSRS	68
5.2	Schematic representation of FPSRS with marching direction of ray on TIS.	69
5.3	Ray tracing algorithm for predicting the behaviour of solar ray.	71
5.4	Grid suitability test for a) CM and (b) PM.	75
5.5	Representation of space dependent parameters (N1) and time-dependent parameters (N2) to obtained N for FPSRS.	77
5.6	The RTA-G used for FPSRS to predict the value of N for various situations.	80
5.7	Change in the grid size with increasing the value of N.	81
5.8	Results of NGRR for TIS of the FPSRS.	81
5.9	Solar radiation received at BRS when N is selected with considering the	83

	CM.	
5.10	Representation of critical zone with use of EGR.	84
5.11	Locating GGI region with help of LC method.	86
5.12	Zone of ‘ <i>illusive convergence</i> ’ using; (a) EGR method and (b) LC method (Exponential view).	87
5.13	Results of CVRMSE for obtaining the value of N.	89
5.14	Results of R ² methods for finding the final value of N according to PM.	90
5.15	Obtaining converged solution v/s grid free solution.	91
6.1	Flowchart of for determining the optimal value of H/B in STC-based FPSRS	96
6.2	Solar irradiation data for (a) SS solar radiation condition (21 st June 2020) and (b) WS solar radiation condition (21 st December 2020)	97
6.3	Results of RDP for obtained the effective H/B in (a) SS and (b) WS, solar radiation condition.	98
6.4	Validation of RTA with results of experimental work in the term of (a) RDP and (b) η_{opt} .	100
6.5	Numerical model of HTC based FPSRS	101
6.6	Numerical model of OTC based FPSRS	102
6.7	The path followed by the ray when reflected from opposite and via neighbour reflectors in the cases of (a) STC and (b) HTC, based FPSRS	103
6.8	The path followed by the ray when reflected from opposite and via neighbour reflectors in the cases of OTC based FPSRS	105
6.9	Representing the PA and NPA in the HTC based FPSRS (a) isometric view and (b) top view.	106
6.10	Representing the PA and NPA in the OTC based FPSRS (a) isometric view and (b) top view.	107
6.11	Marching direction of the core point on the TIS of the HTC based FPSRS.	109
6.12	Representation of the RDP for STC and HTC-based FPSRS for various values of θ as per the ray classification in Table 4.2.	111
6.13	Overall performance of FPSRS in (a) SS and (b) WS, solar radiation condition	113
6.14	RDP for the different classification of the rays under (a) SS and (b) WS, solar radiation condition for HTC based FPSRS	114
6.15	Representation of the RDP for STC and OTC-based FPSRS for various values of θ as per the ray classification in Table 4.2.	116
6.16	Representation of the RDP for HTC and OTC-based FPSRS for various	118

	values of θ as per the ray classification in Table 4.2.	
6.17	Representation of the RDP for all the cases of the rays when (a) HTC based FPSRS and (b) OTC based FPSRS	119
6.18	Change in η_{opt} for OTC-based FPSRS under (a) SS and (b) WS solar radiation conditions	119
6.19	Optical performance of OTC-based FPSRS for different cities of the India	120
A.1.1	The equation of time E in minutes as a function of the year	147
C.1.1	Adequate number of incoming rays on TIS.	161
C.1.2	Letter of USD 10,000/- received from the Solcast	163